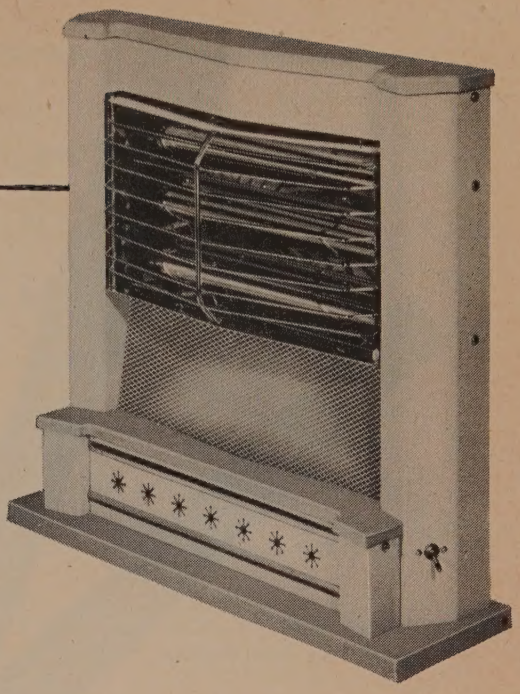
ELECTRICAL REVIEW

FRIDAY
DECEMBER 1960

WEEKLY
PRICE 1s 6d

Heatrae

THE FIRES THAT ARE BORN OF EXPERIENCE



THE "BALLERINA" 2kW

A brilliant combination of contemporary styling and Heatrae workmanship, the "Ballerina" is both extemely attractive and highly efficient. It is designed primarily as a free-standing unit.

THE "MAJESTIC" 2kW

Equally appropriate in traditional or contemporary surroundings, the Majestic is essentially a hearth fire. Cleverly diffused illumination provides a cheerful glow and adds to the look of comfort.

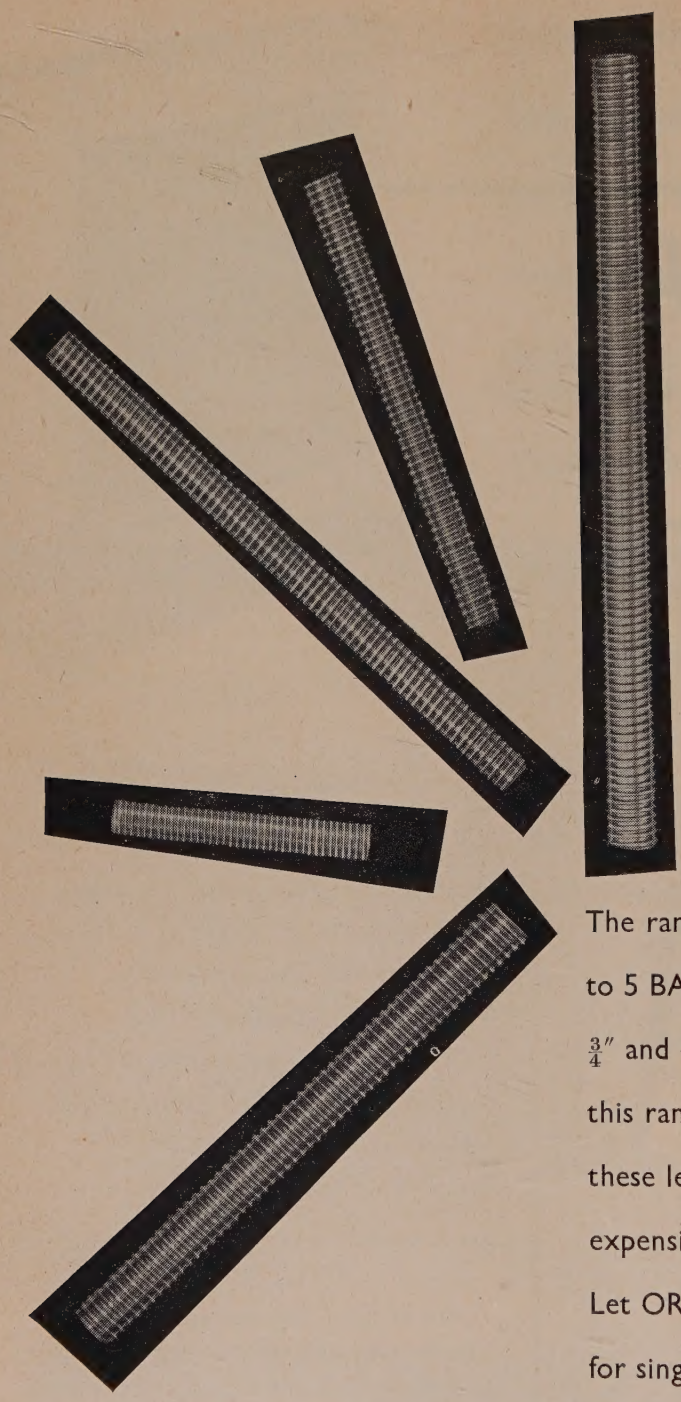
Both of these fires incorporate the latest embedded rod heating elements. The load is disposed on three 666 watt elements and is controlled by a unique 3 HEAT SWITCH ARRANGEMENT for one, two or three elements. The extra long elements give a very wide spread of heat.

Write today for
LEAFLET No. 98

HEATRAE LTD

NORWICH · NORFOLK · NOR 29A · ENGLAND

Telephone: NORWICH 25131 *Telegrams:* HEATRAE NORWICH



all threads

The range in both Brass and Steel is from 0.BA to 5 BA and $\frac{1}{4}$" to $\frac{1}{8}$" diameter and between $\frac{3}{4}$" and 4" long. Recommended for use within this range, with rolled threads, where studding in these lengths in cut threads would be too expensive. Please send for stock lists.

Let ORMOND quote for all Repetition Parts—for single and multi-spindle automatics up to $1\frac{1}{4}$" diameter; Brass, Steel and Light Alloy Screws in Rolled and Cut Threads, Grub-screws, Nuts, Hexagonal Bolts and Set-screws, turned from bar and Cold Headed Grades "A," "B" and High Tensile.

ENGINEERING ORMOND COMPANY LTD.

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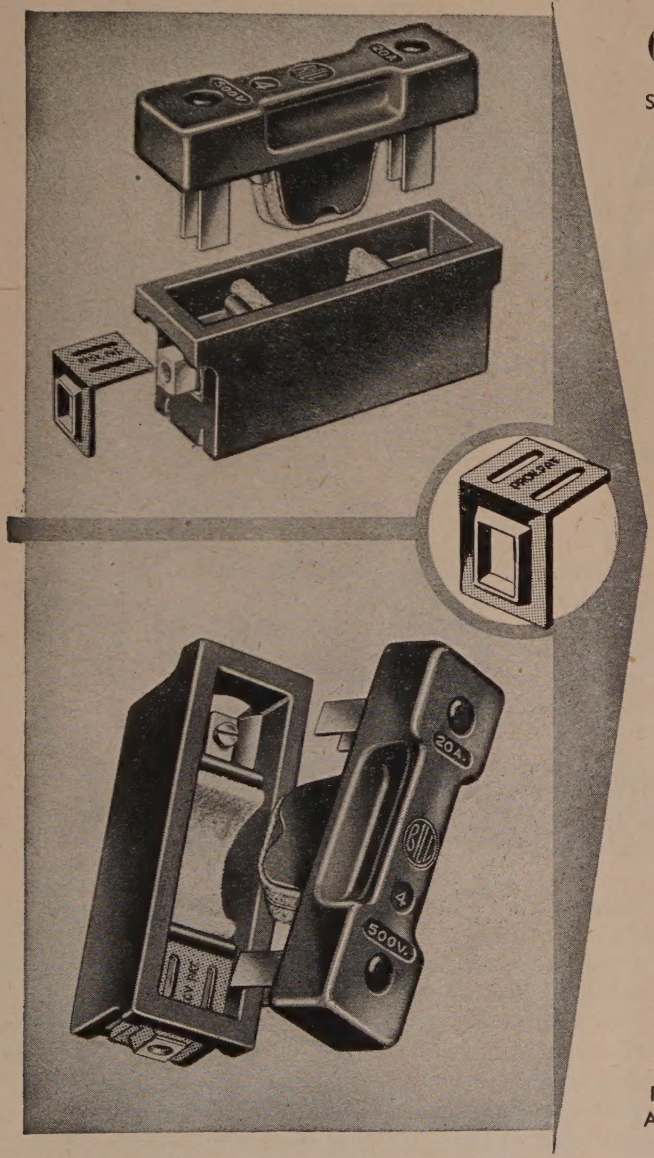
Ormond House, Rosebery Avenue, London, E.C.1 Telephone: TERminus 2888 Telegrams: Ormondengi, Cent

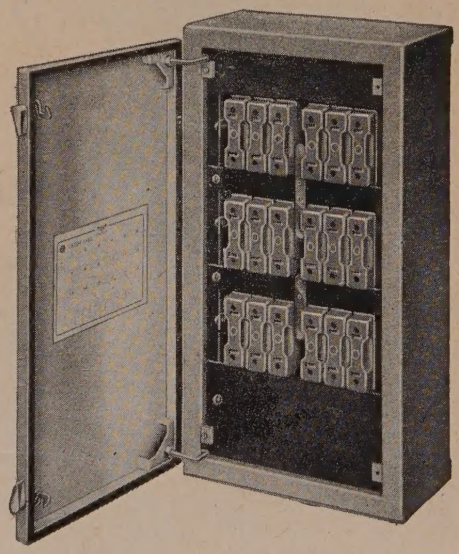
You cannot buy better gear

SAFETY BILL SHIELDS



BILL ARC DAMPING TYPE OR H.R.C. DISTRIBUTION FUSEBOARDS ARE NOW FITTED WITH THE BILL SAFETY SHIELDS (PROV. PAT.) AS ILLUSTRATED.

FUSEBOARDS ARE AVAILABLE WITH NO PRICE INCREASE IN ALL SIZES OF 15/20 AMP. AND 30 AMP. RATINGS.



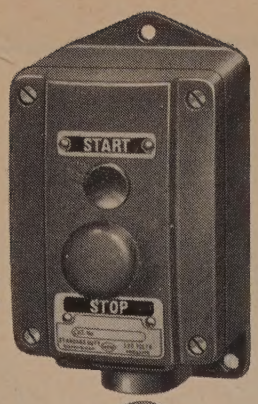
THE INTRODUCTION OF PROTECTIVE SHIELDS FITTED OVER THE LIVE CONTACT ENDS IN THE FUSE BASES GIVES ADEQUATE PROTECTION AGAINST ACCIDENTAL CONTACT WHEN THE FUSE CARRIERS ARE WITHDRAWN.

THE SHIELDS ARE STRONG DURABLE MOULDED NYLON AND FORM AN INTEGRAL PART OF THE BUSBAR FUSE CONTACT ASSEMBLY AND CANNOT ACCIDENTALLY BECOME DETACHED.

BILL SWITCHGEAR LTD

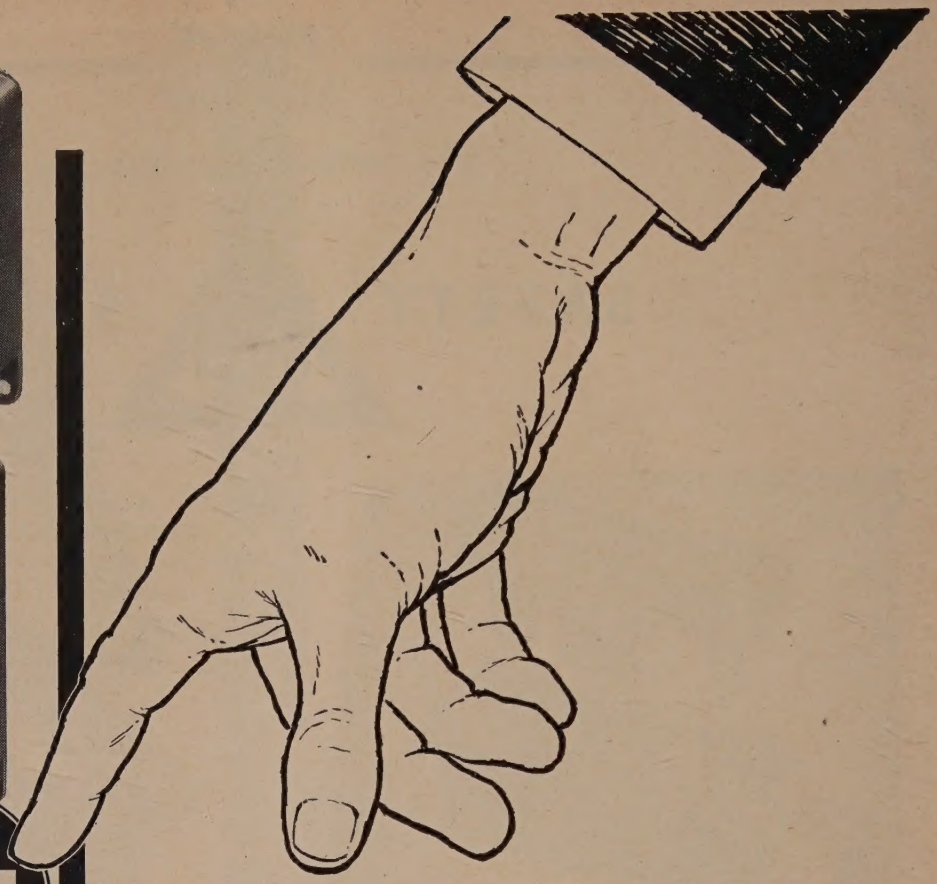
BIRMINGHAM·20

LONDON, S.W.1 A. W. ZELLEY, N. PAYNE, R. W. HANKINSON GILLINGHAM ST. | MIDLANDS G. H. GARBETT, H. WILLIAMS HEAD OFFICE | NORTH MIDLANDS C. G. BACHELOR HEAD OFFICE | EAST MIDLANDS J. A. PEARCE, HEAD OFFICE | BRISTOL, 3 W. L. WHITE, CHURCH LANE | LEEDS, 14. N. SHARPLES, G. SUTTON, WOODLANDS FACTORY. | CHELTENHAM C. GEARING, HIGH ST. | MANCHESTER 3 H. H. POLLARD, J. H. RAMSAY, F. A. MAYOR, WOOD STREET | GLASGOW J. D. HARRIS, SANDYFORD PLACE | BELFAST J. BALLENTINE DONEGALL ST.

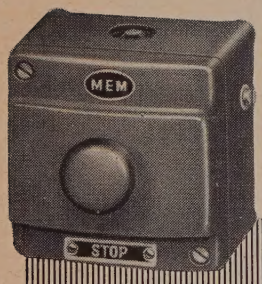


Watertight pattern surface mounting 2 CSU/W "Start"—"Stop"

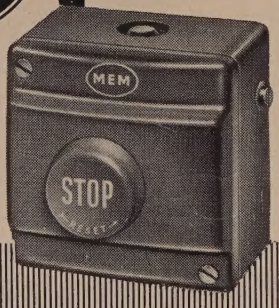
Watertight pattern surface mounting 3 CSU/W "Forward"—"Reverse"—"Stop"



MEM Push Button Control Stations

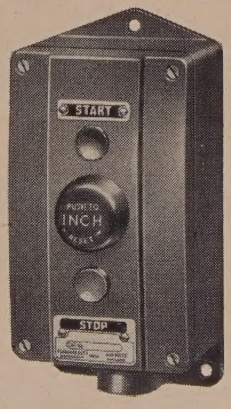


Surface mounting enclosed pattern 1 CSU "Stop" only



Surface mounting enclosed pattern 1 CSU/L Push to lock "Off" Turn to release

Surface mounting enclosed pattern 2 CSU "Start"—"Stop"



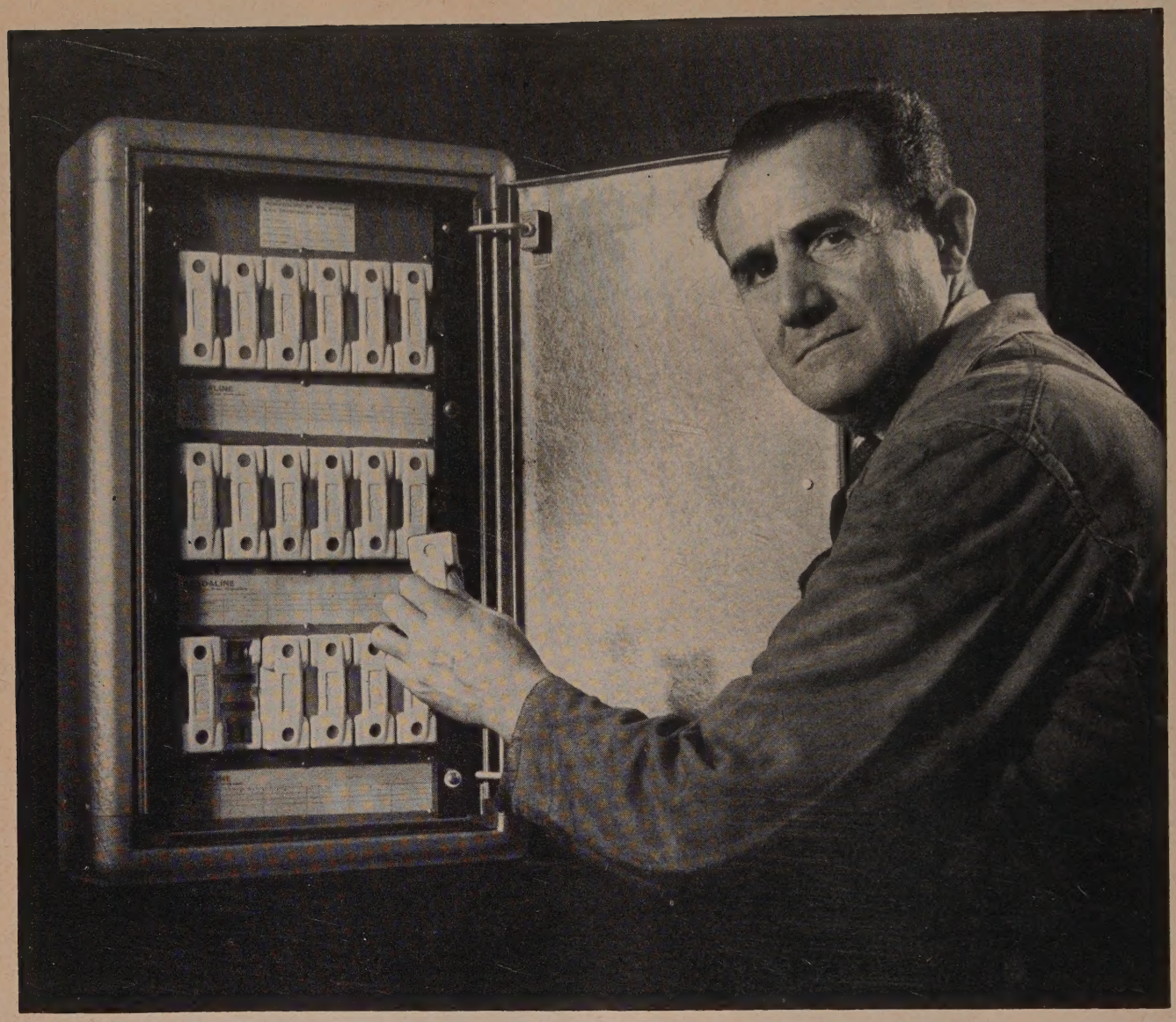
Watertight pattern surface mounting 33 CSU/W "Start"—"Inch"—"Stop"

MEM Push Button Control Stations meet every requirement associated with the remote control of electric motor starters. In addition to the models illustrated, the range includes flush inset patterns for recessing into machine tools, etc., and back entry models for suspension by conduit. Forty different models are available from which to make a choice. A wide range of Control Stations is also available for use on machine tools and other equipment intended for export to Canada. These models are C.S.A. Approved and bear the C.S.A. Approvals No. 13216.

write for List No. 446

MEM

MIDLAND ELECTRIC MANUFACTURING CO. LTD., REDDINGS LANE, TYSELEY, BIRMINGHAM 11



simply a matter of confidence

Ask any experienced electrical man. He'll tell you right away that you can have absolute confidence in anything Sanders make. No ifs, buts or doubts. If it's a Sanders job it's the best obtainable and it will never let you down. Take the SANDALINE Fuseboard, for instance, designed to meet today's modern requirements. With its ingenious smooth line case, detachable ends and sides, the 'Sandaline' has easily reversible fusebanks all making for ease and speed of wiring. Rewirable or H.R.C. Fuse Carriers can be fitted at will, since the 'Sandaline' has the tried and proved 'Sandaspeed' Duplex Fuse Units originated by Sanders. Absolutely rigid and dustproof, and incorporating a cylinder type lock with interchangeable keys, the 'Sandaline' Fuseboard is finished in steel-hammered grey stove enamel inside and out. But that's not all. It's a quality job. It's that little bit better than the best. In short, it's a Sanders job.

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WILLIAM SANDERS & CO. (WEDNESBURY) LTD. - FALCON ELECTRICAL WORKS - WEDNESBURY - STAFFS.

132 kV fully insulated high speed resistor on-load tap changers installed on our 120 MVA 275/132 kV Auto-transformer at C.E.G.B. Northfleet Super-grid Sub-station.

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We have designed and constructed On-load tap changing equipment for the widest range of applications. We have supplied equipments on our own transformers and to other transformer manufacturers for over thirty years. Our confidence in our tap changers is such that we guarantee a contact life of at least two hundred thousand operations – approximately twenty years' service.

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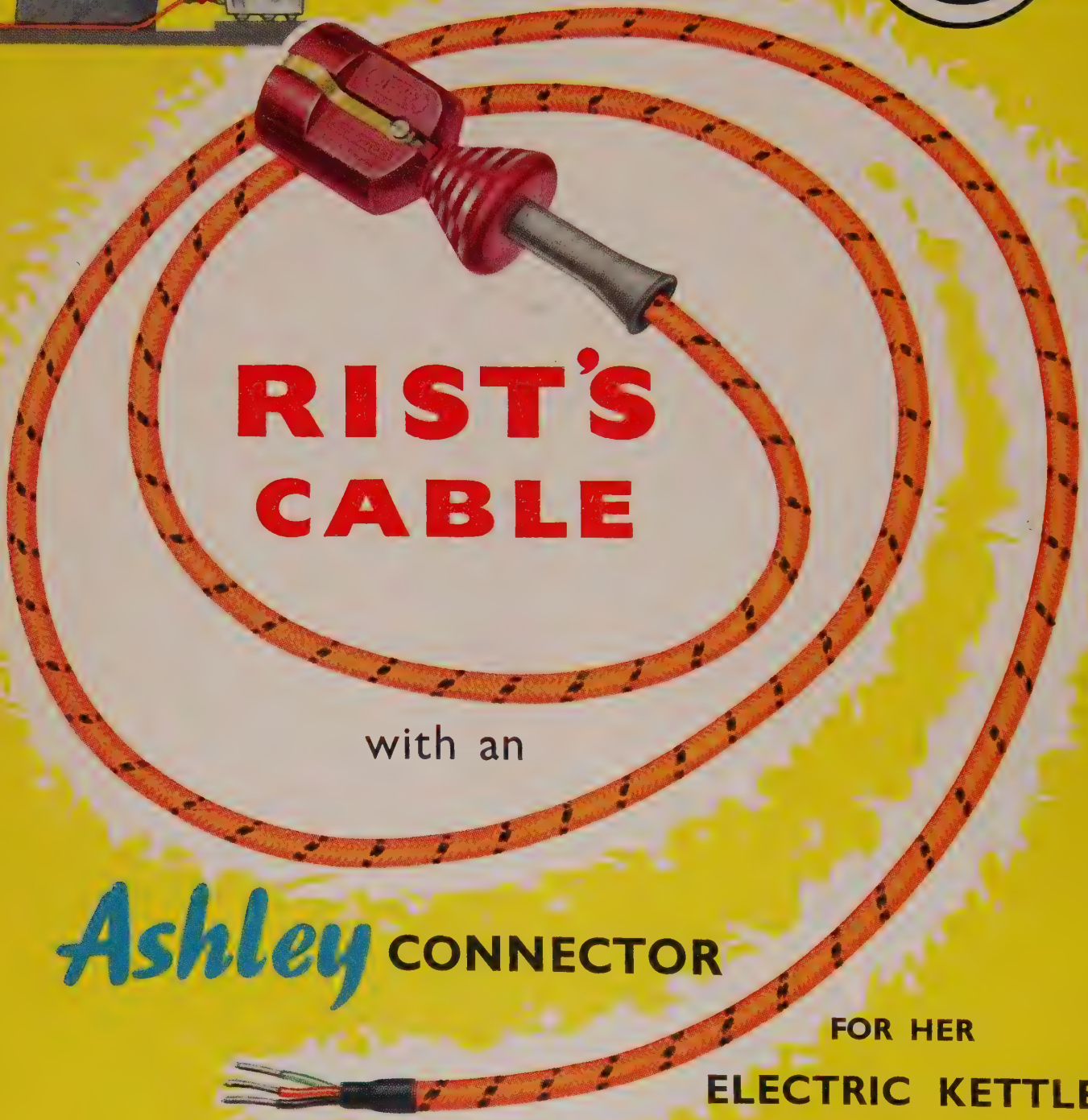
RIST'S



RIST'S CABLE

with an

Ashley CONNECTOR

FOR HER

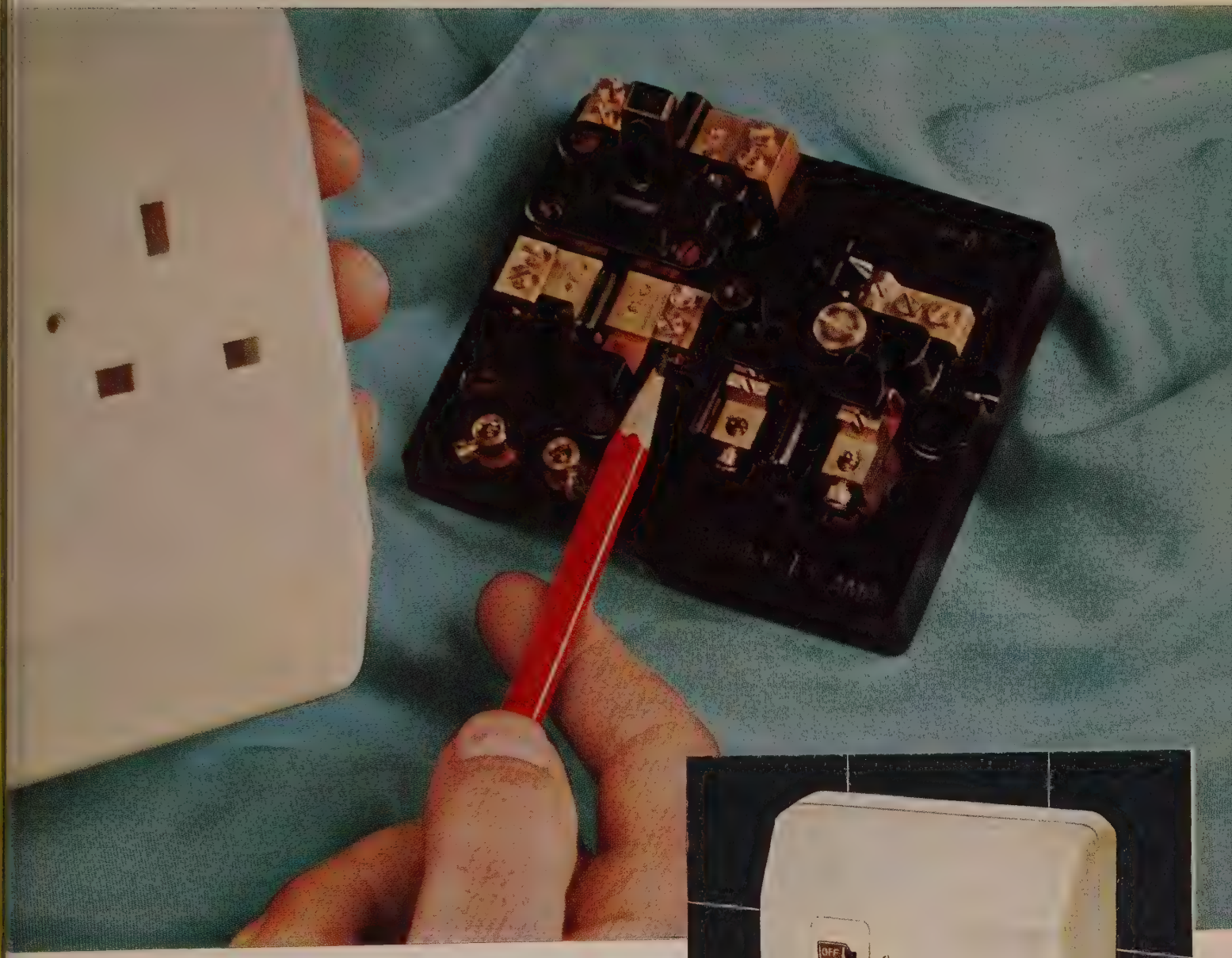
ELECTRIC KETTLE

RIST'S WIRES & CABLES LTD

LOWER MILEHOUSE LANE, NEWCASTLE, STAFFS.

Distributors: LYMELITE ELECTRICAL INDUSTRIES LTD., 134 Pentonville Rd., London N.1. Tel: TER

Wylex build quality
into Sonex Cooker Units



Admired by consumers for attractive, easy-to-keep-clean design Sonex Cooker Units demonstrate the extra WYLEX quality in every feature. Electricians appreciate the 45 amp. rating, and the reliability of the *proven* WYLEX switch.

The Sonex range of Cooker Units includes All-Insulated 45 amp. (with or without Pilot Light) and All-Insulated 60 amp. Also Metalclad Surface and Flush 45 amp. All with B.S. 1363 outlet.

Wylex build quality into...
SWITCHES · SWITCHED SPUR BOXES · COOKER UNITS
SWITCH FUSE CONTROL UNITS · PLUGS & SOCKETS

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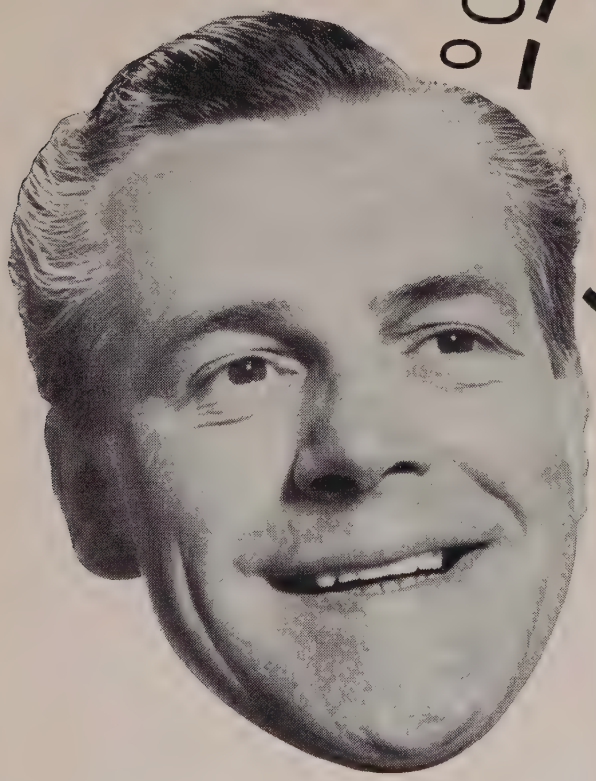
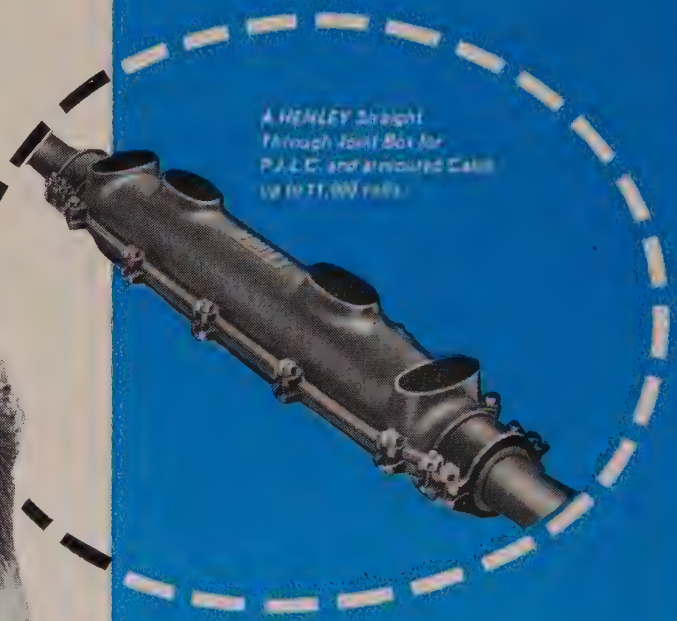
DISTRIBUTION PROBLEM?





Distribution pillars and panels—Underground disconnecting boxes, branch boxes, service boxes and straight-through joints—Indoor and outdoor terminal boxes—Indoor and outdoor service fuses—H.T. and super-tension joints and sealing ends—Overhead service accessories—Rising mains systems—House service fuses and consumers' control units—Jointing materials and accessories of every description.

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FOR EVERY TYPE OF INDUSTRY

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Control desk for main and auxiliary drives on a colour printing press

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OR
MADE TO ORDER

CONTROLS FOR

HEATING

LIGHTING

STARTING

EMERGENCY SUPPLIES

PROCESS CONTROL

LIFTS

A panel for the control of 12 HP slip-ring lift motor

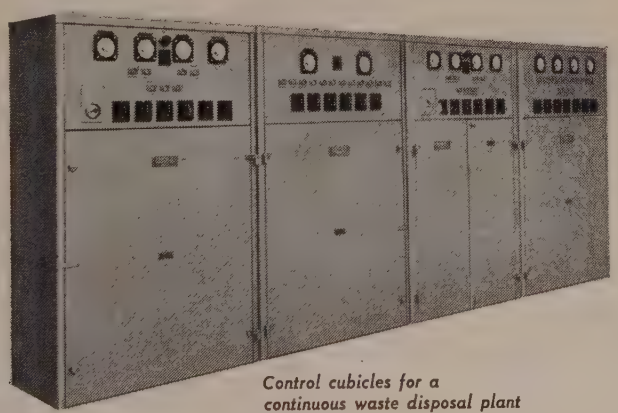
PROCESS CONTROL

CONTACTORS –

SIZES FROM 15 AMPS TO 600 AMPS

ALSO

SPECIAL MARINE AND SHOCKPROOF TYPES



Control cubicles for a continuous waste disposal plant

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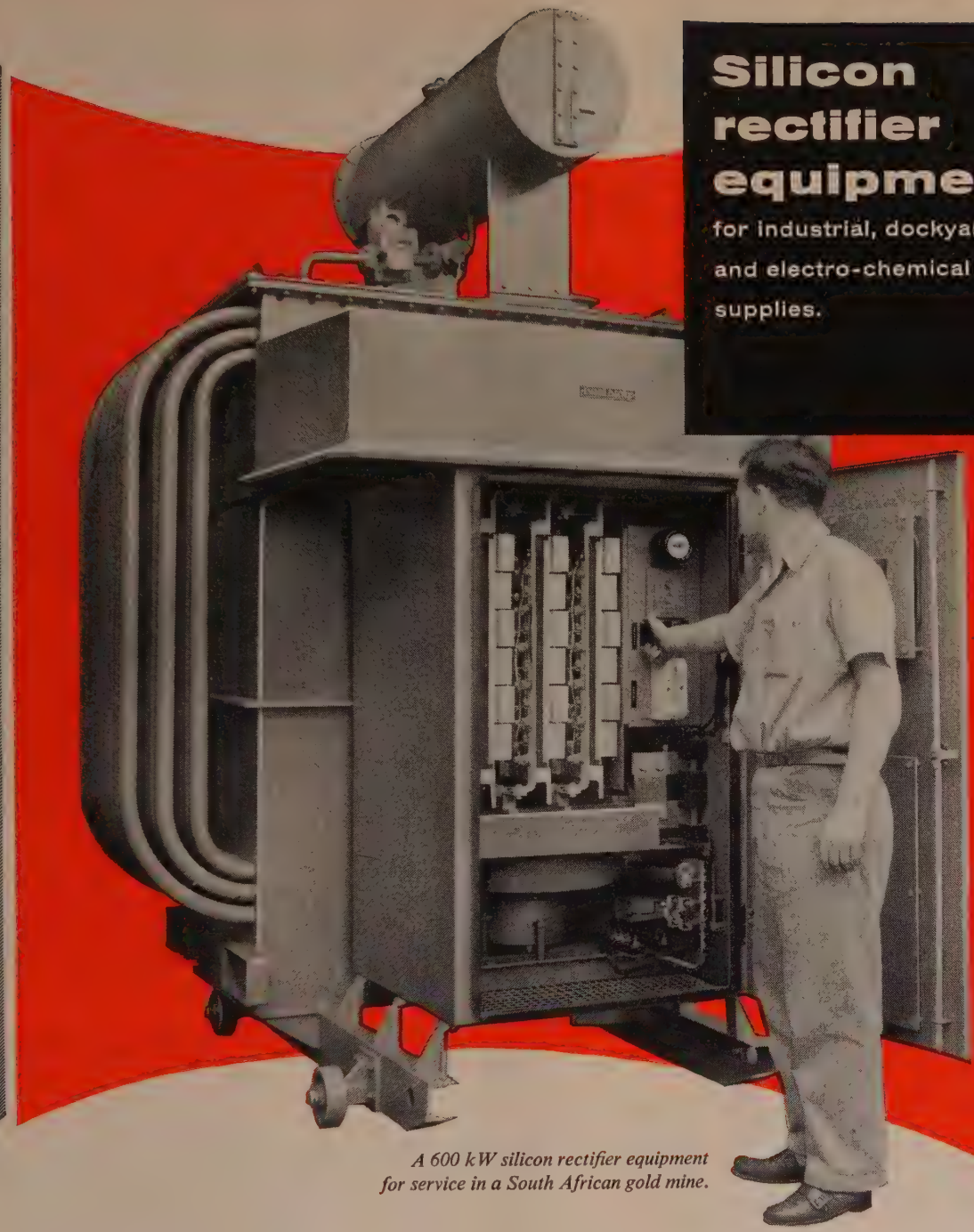
C

Silicon rectifier equipments

for industrial, dockyard and electro-chemical supplies.



A 600 kW silicon rectifier equipment for service in a South African gold mine.

'ENGLISH ELECTRIC' silicon rectifier equipments are available up to the highest outputs for indoor and outdoor service. These equipments are inherently simple and reliable and occupy small space for a given output. The transformer, rectifier and control gear may be purchased as a composite equipment or as separate units.

SEND FOR PUBLICATION RS/129 to:
The ENGLISH ELECTRIC Company Limited, Rectifier Substation Department, Stafford.

'ENGLISH ELECTRIC'
silicon rectifiers

THE ENGLISH ELECTRIC COMPANY LIMITED, ENGLISH ELECTRIC HOUSE, STRAND, LONDON, W.C.2.
WORKS: STAFFORD · PRESTON · RUGBY · BRADFORD · LIVERPOOL · ACCRINGTON

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progress & efficiency

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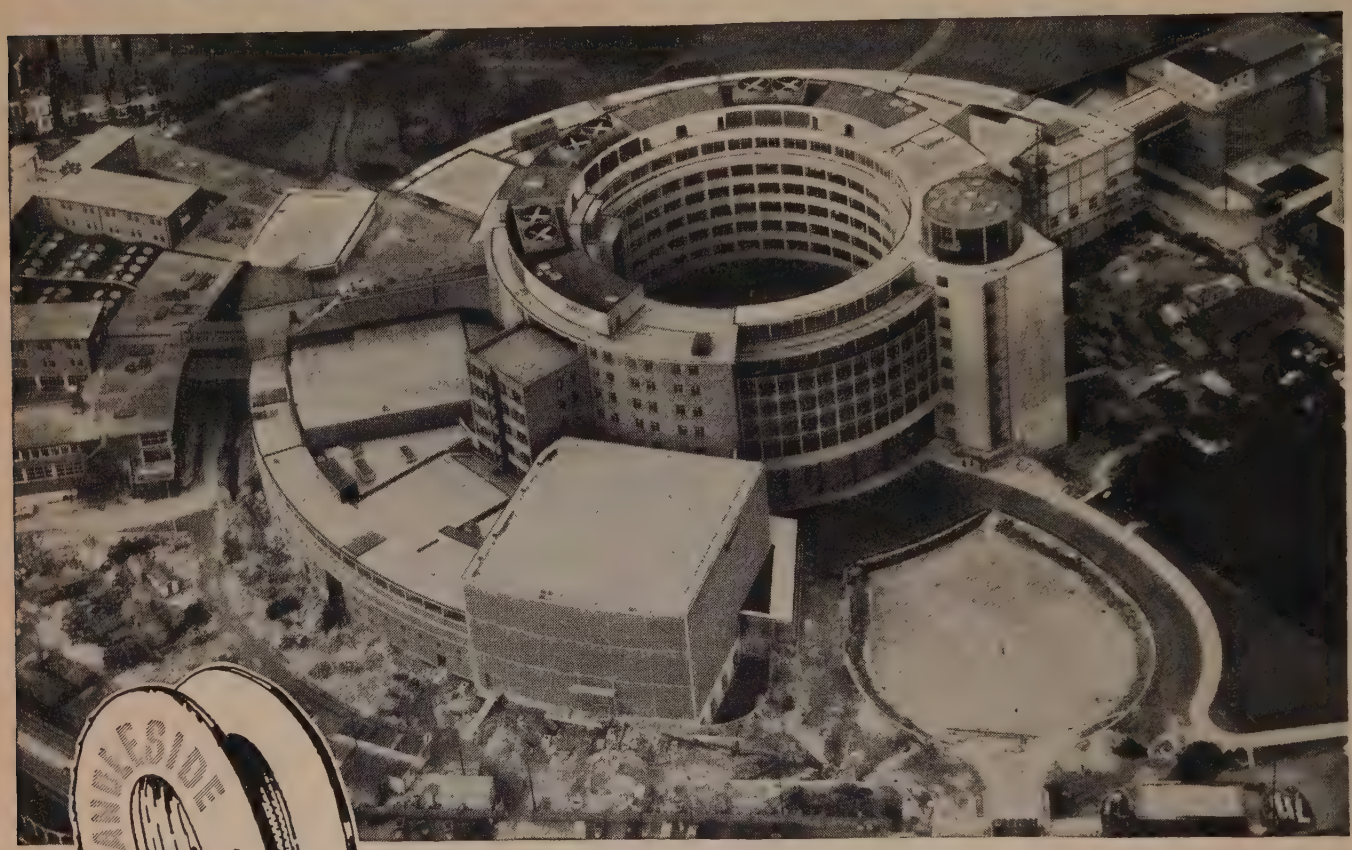
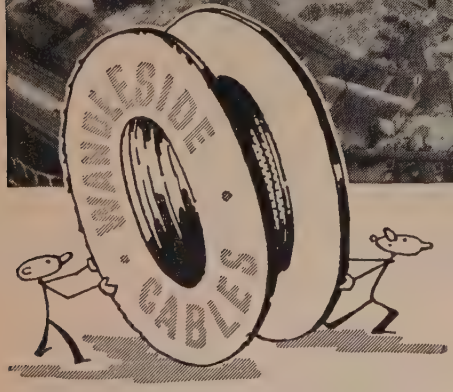
WANDLESIDE CABLES

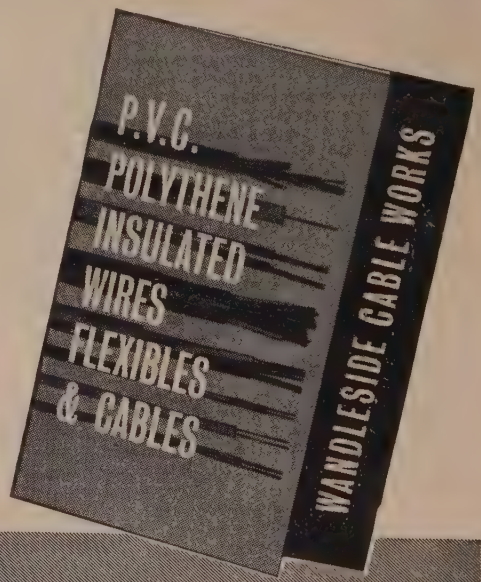


The new B.B.C. Television centre uses Wandleside Cables.
(Photograph by courtesy of the B.B.C.)



Every type of cable produced in the three factories of the Wandleside Cable Group is subjected to the most exacting tests to comply with the British Standard, Government or other relevant Specification. Reliability is our watchword. This is why you will find Wandleside Cables carrying the load in every major project in the Television, Radio, Electrical, Electronic and Aircraft Industries.

Our new catalogue gives you details and specifications of our range of Thermoplastic Insulated Wires and Flexibles.
We will gladly send you a copy by return of post.



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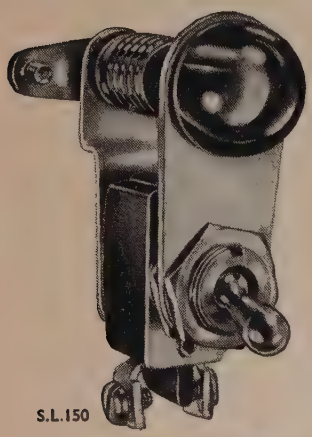
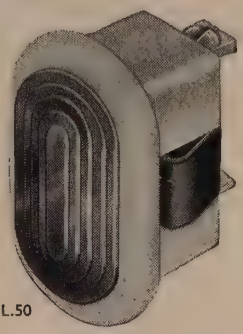
Tel: VANdyke 7544 (7 lines) (In FALKS Group) Teleg: Wandleside, London

Arcolectric Signal Lamps


S.L.162

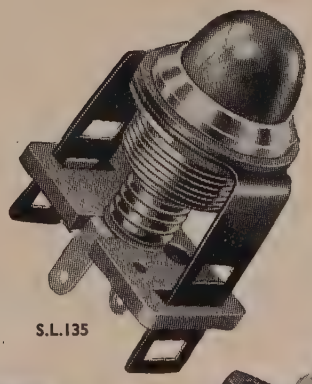

S.L.160


S.L.150

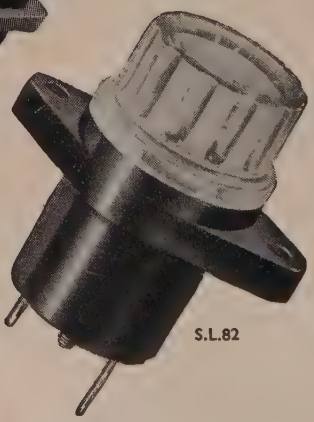

S.L.50

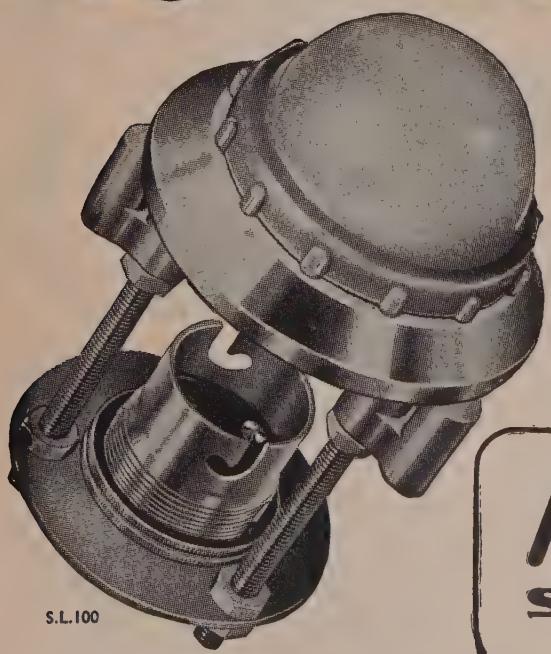

S.L.130


S.L 90/SB


S.L.135


S.L.86


S.L.82


S.L.100

Neon for 80—600 volts

S.L.162 and S.L.160 : New miniature low cost neon signal lamps. ¼" hole fixing. Completely sealed against moisture.

S.L.50 : Snap-in fixing.

Low Voltage

S.L.130 : New high quality design for M.B.C. (M.C.C.) bulbs. Also available with M.B.C. neon.

S.L.90/SB : Popular M.E.S. holder. Services No. 10AE/413.

S.L.135 : Adjustable M.E.S. holder.

S.L.150 : Combined toggle switch and M.E.S. signal lamp.

S.L.82 : M.E.S. holder ZA 4201.

S.L.86 : Low cost M.E.S. holder.

Mains

S.L.100 : For 15 watt B.C. sign lamps.

A similar but smaller S.B.C. holder is available for S.B.C. 10 watt lamps.

Write for Catalogue No. 132

ARCOLECTRIC SWITCHES · LTD

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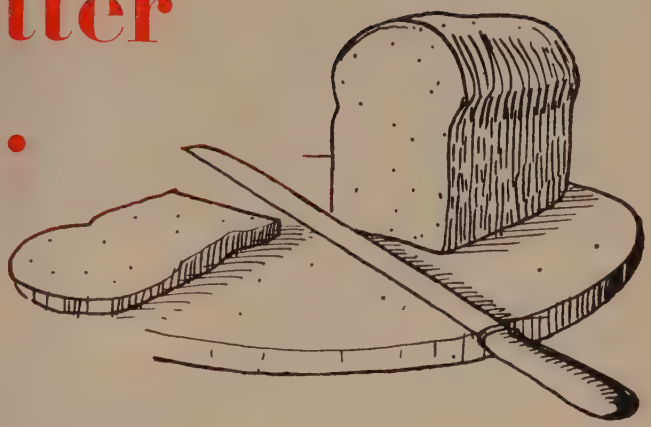
Bread and butter business . . .



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In addition to extensive development work in the fields of new materials and methods for the electrical and mechanical industries, The Delanco Company, has at the same time, to keep up the supply of a host of machined and turned parts, in a multiplicity of shapes and sizes, and in materials non-metallic.

Strength in relation to size, insulation properties, drilling and tapping propensities, all have to be provided for and in materials ranging from vulcanized fibre to glass fibre.

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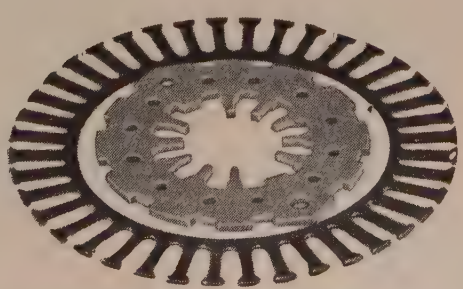
Delivery and service second to none and a courteous and knowledgeable reception to your enquiry. You will want to know more about this service, so get in touch with DELANCO . . . NOW . . .



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Delanco Electrical Insulation

LEONARD ST. E.C.2

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* P.E control

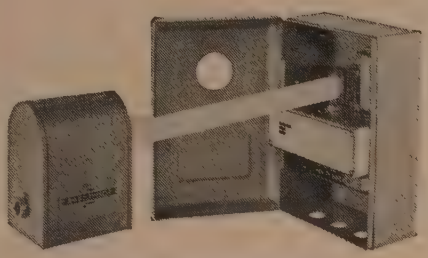
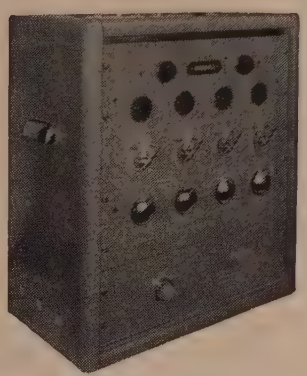


Photo-electric relay type Q.56
Uses include:—on-off switching; automatic spraying; length cutting gauge; conveyor control; process control; height gauge; limit switch; loop control; warning device; paper breakage indicators; alarms, etc. etc.

"Motoload" relay
Many factors can be measured or guarded against by keeping a check on the current of a driving motor. The Relay senses the torque of a driving motor and responding immediately to load variations, switches off the motor, indicates the variations or performs some other desired operation.



Counting and batching
Counting rates up to 20,000 per minute can be recorded and batching units divert succeeding articles after a chosen number has passed through the light beam.

There isn't a production plant anywhere that couldn't be made (or hasn't been made) more efficient, more economical by the use of Radiovisor Photo-electric and Electronic Controls

* **P.E.** is photo-electric

It costs nothing to consult us—
We have over thirty years' experience

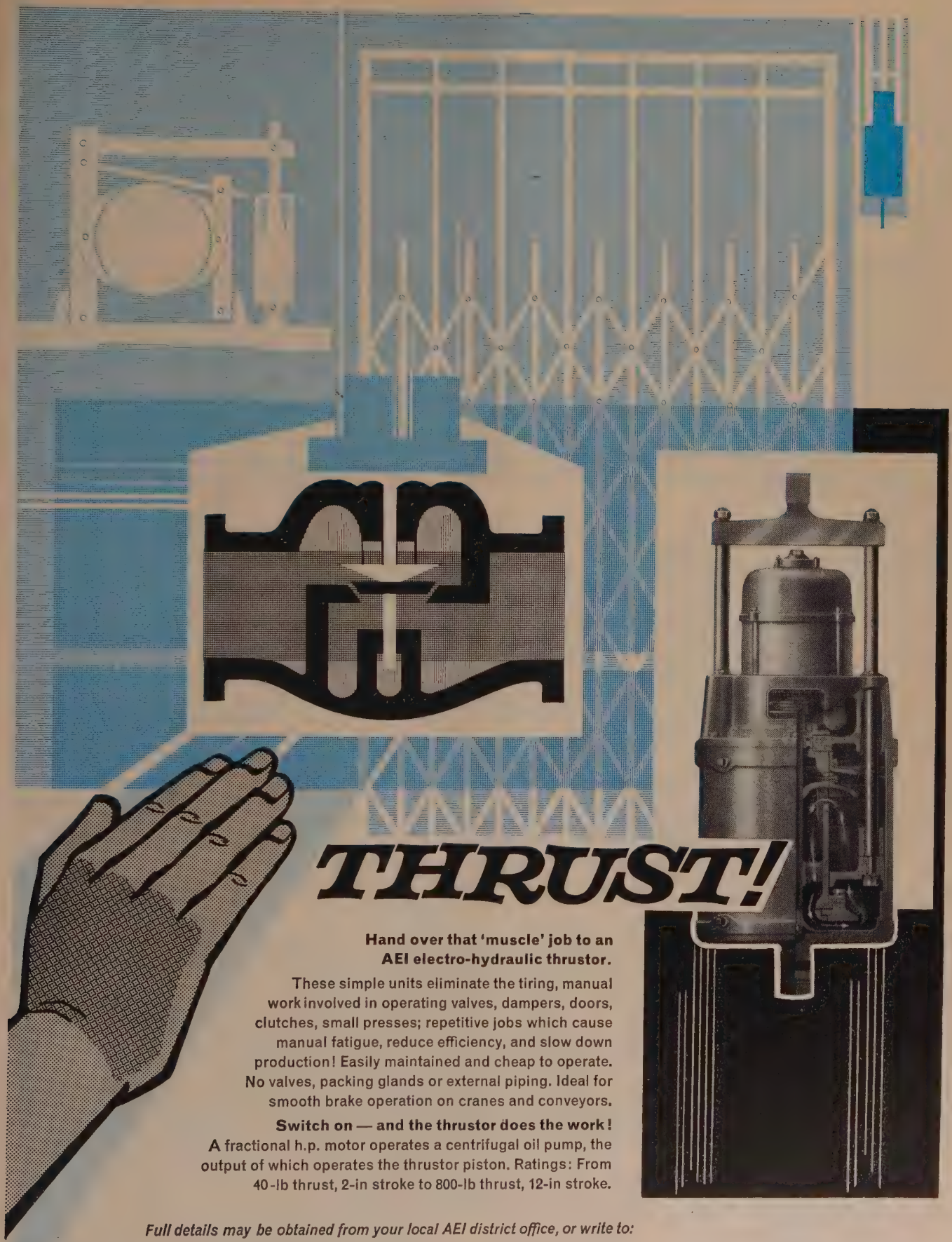
RADIOVISOR P.E control

MAKERS OF THE MOST COMPREHENSIVE RANGE OF PHOTO-ELECTRIC CONTROLS IN THE WORLD

Radiovisor photo-electric and electronic controls include:

Flamestat Flame Failure Control • Smoke Detector Fire Alarm Sequence Control • Counting and Batching Unit • Invisible Ray Burglar Alarm • Turbidity Equipment • Hopper and Bunker level Control • Print Registration • Photo-electric Safety Guard • Factory Lighting Control • Automatic Radiation Pyrostat • Automatic Door Opening • Industrial Smoke Density Indicator and Alarm Resistance Welding Control

RADIOVISOR PARENT LIMITED, Stanhope Works, High Path, London, S.W.19
Telephone: CHErrywood 3351 Telegrams: Radivisor, London, S.W.19



THRUST!

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These simple units eliminate the tiring, manual work involved in operating valves, dampers, doors, clutches, small presses; repetitive jobs which cause manual fatigue, reduce efficiency, and slow down production! Easily maintained and cheap to operate. No valves, packing glands or external piping. Ideal for smooth brake operation on cranes and conveyors.

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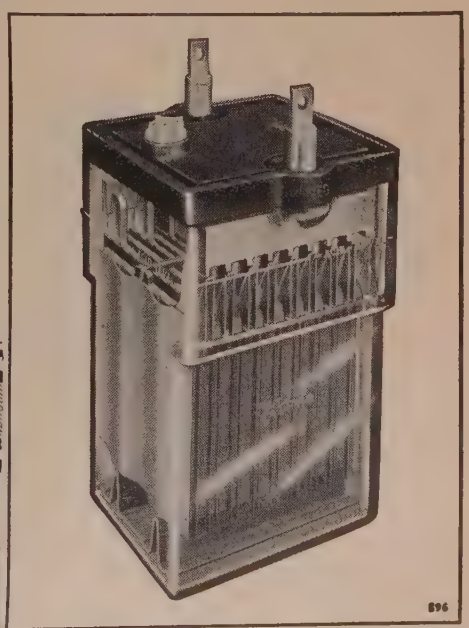

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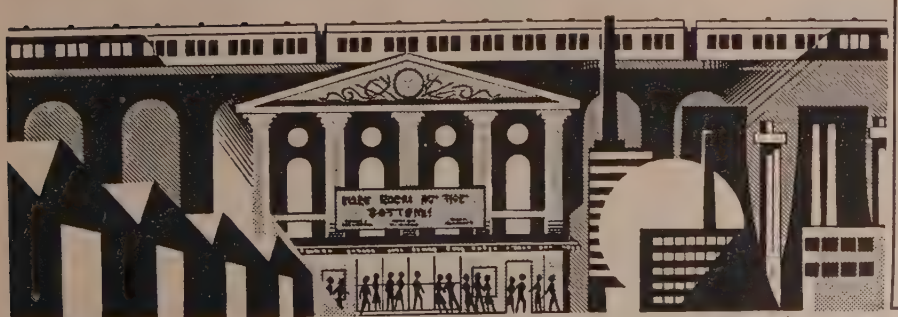

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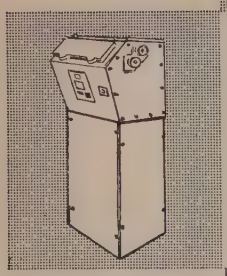
The fuse-links are fully A.S.T.A. certified in accordance with the requirements of B.S. 2692.

Purpose



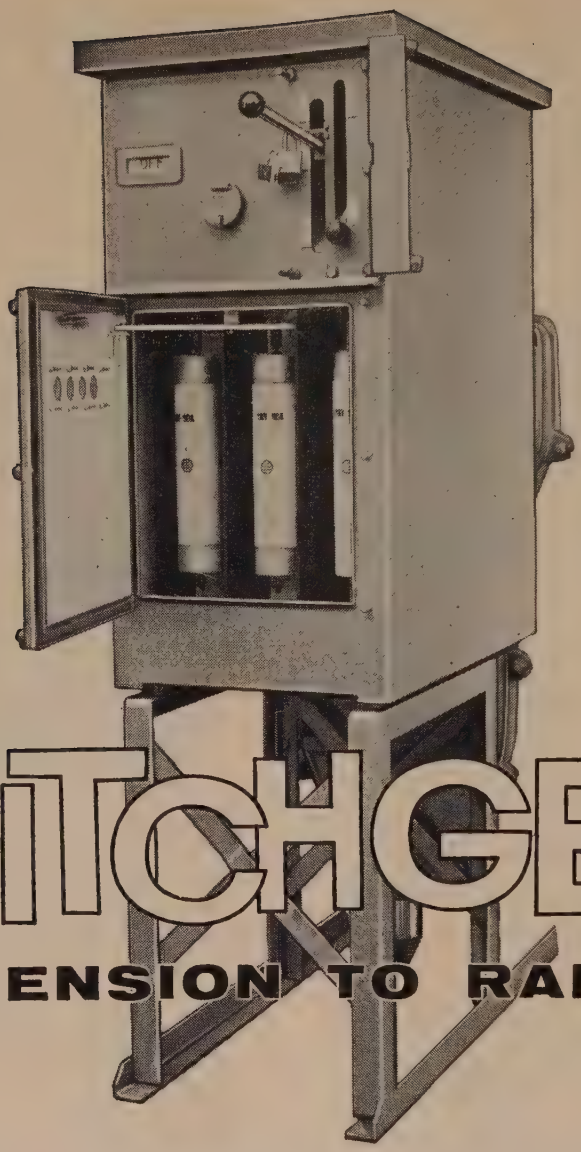
Suitable for use in H.V. fuse-switches requiring a 10″ × 2½″ oil-immersed cartridge fuse-link fitted with striker-pin tripping-device.

Manufacture

Every stage of manufacture is subject to careful quality control to ensure, amongst other things, complete oil-tightness. All fuse-links are checked by X-ray examination during and after assembly.

Type Test Data

RATING		BREAKING-CAPACITY	A.S.T.A. CERTIFICATE NO:
CURRENT(amps)	VOLTAGE (kV)		
60	6·6/11	250 mVA at 11 kV	3866
60	6·6/11	250 mVA at 6·6 kV	3976
60	6·6/11	150 mVA at 6·6 kV	3977
60	3·3	75 mVA at 3·3 kV	4013
100	3·3	75 mVA at 3·3 kV	4061



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FRIDAY
23 DECEMBER
1960

ELECTRICAL REVIEW

IN THIS ISSUE

Universal Electricity 1063
Some observations on the theory of astrophysical phenomena and universal evolution expounded in this issue by Dr. C. E. R. Bruce

Fast Reactors 1065
The Dounreay fast reactor was the subject of a symposium held recently in London. In this article Mr. R. V. Moore, Deputy Managing Director (Projects), U.K.A.E.A. Development and Engineering Group, deals with the characteristics of the fast reactor and its place in an integrated nuclear programme

An All-Electric Universe 1070
The theory of evolution of the universe put forward by Dr. Bruce is that electrical discharges have gradually condensed matter from the primordial gas and dust of a general universal atmosphere, first into galaxies and then stars, with the ultimate formation of planets and satellites

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British Patents Procedure 1078
Requirements to be met in the filing of patent applications and specifications and the meanings of the various relevant dates

Automation or Frustration? 1081
A series of imaginary events showing how dependent we are on electrical science

Micro-Miniaturisation 1097
In a lecture given at a meeting of the I.E.E. Electronics and Communications Section this week the author spoke of the present interest in microminiature electronic circuits and gave some typical examples, including a proposed British circular component wafer 0·45in in diameter

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ELECTRICAL REVIEW

23 December 1960 Vol. 167 No. 26 Established 1872

Universal Electricity

TODAY we publish as our " Christmas cracker " a detailed explanation of Dr. C. E. R. Bruce's electric field and discharge theory of astrophysical atmospheric phenomena and universal evolution. This is the first general survey of the author's work to appear in this country since the initial version of the theory was published sixteen years ago. At first sight, these may seem strange topics for the pages of the *Electrical Review*, but they do not seem so strange when it is realised that the theory came into being as a result of research work on the circuit-breaker arc and the effect of the lightning discharge on overhead power transmission lines, and it has always retained this close association with the types of electrical engineering problems familiar to our readers.

The cosmic electric fields referred to by Dr. Bruce appear to derive from the same physical processes as are operative in the generation of static electricity, that rather tiresome industrial hazard, and also in thunderclouds. Quite recently, Dr. Bruce has shown that there is a close link between the forces which mould the galaxies and the arc welding process, the physical basis of which has been elucidated contemporaneously by his colleagues in the Electrical Research Association. It is this aspect of the theory which will surely intrigue electrical engineers, to whom Dr. Bruce's earlier work on more mundane electrical discharge problems will be well known. This, it may be remembered, was twice recognised by the award of the Kelvin Premium by the Institution of Electrical Engineers. Like the present work, this too involved the upsetting of existing theories of the nature of the lightning and arc discharges.

What is perhaps the most exciting item for the electrical and thermo-nuclear engineer is the description of a successful cosmic " Zeta " which is already 6,000 British billion miles long, and about one-tenth as wide. It is operating at a temperature of 400 million degrees K, extending at the rate of 2,500 miles a second and will continue to do so for a period of from ten to a hundred million years! It is in this sort of arrangement that the author endeavours to show that electrical discharges have gradually condensed matter from the primordial gas and dust of a universal atmosphere, first into galaxies and then from the condensed matter of the galaxies into stars. Discharges in the extended atmospheres of stars further condensed the

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The Editors wish readers a Happy Christmas and hope that the coming year will be one of expansion and prosperity for the industry

matter, ultimately to allow the formation of planets and satellites.

So far the reaction of astrophysicists to these new ideas has been rather negative. In fact they do not believe it! However, as the present article shows, the theory has solutions to offer where none are at present available, and we would submit that the stage is long passed at which it would be more surprising if it were wrong, than if it were right.

The electric field and discharge, or " thunderstorm," theory of astrophysical atmospheric phenomena would appear to offer a general panacea for most of the major ills to which current astrophysical theories are heirs. Without it, entirely separate postulates are required in relation to cosmic magnetic fields, relativistic electrons, cosmic gas jets, the sudden appearance of high excitation in otherwise cold atmospheres, and the aggregation of matter as in spiral stellar and galactic nebulæ. Our readers can judge for themselves what conclusions are to be drawn from the success of so many of the theory's outstanding and quite surprising predictions, in such fields as galactic evolution and magnetic storms in which current theories are silent as to the nature of the primary causes.

MORE RAILWAY DIFFICULTIES

In last week's issue we had to comment on control circuit modifications necessary with the rolling stock introduced in the recent electrification of some lines from Liverpool Street Station in the Eastern Region of British Railways. These are being made to prevent a recurrence of trouble in the form of burnt-out traction motors that has been experienced. Since then more difficulties have been encountered, this time on the new Scottish Region trains in the Glasgow area, where an explosion due to a transformer failure regrettably caused personal injuries. Other failures have occurred and these trains have now been withdrawn from service for an indefinite period while the fault is corrected. Such a move, although necessary in the public interest, could well have serious effects on confidence in railway electrification.

Full details of the faults and the steps which have been and can be taken to correct them will have been given at the public inquiry which opened yesterday (Thursday) and until we have these we cannot comment on the cause. There are, of course, many questions to be answered, not least concerning the failure of extensive trials (some of these trains have been running for some fifteen months) to discover faults which became manifest several times in five weeks' commercial operation. Four major electrification works have been inaugurated in the last quarter of this year, and with such an intensive programme it would not be surprising if " teething troubles " were met, but not to the present degree. The trouble is not confined to the products of any one manufacturer—first G.E.C., now A.E.I.—suggesting that the 25 kV 50 c/s system has more inherent difficulties than had first been supposed. It must also be remembered that no amount of experience achieved with well-established and proved methods of electrification can assist completely with the development of an entirely new system—the application of which to multiple-unit train working is being pioneered in this country.

ELECTRIFICATION INCREASES TRAFFIC

During the first month of electrical operation traffic on the Glasgow suburban railway line north of the Clyde more than doubled. Possibly the novelty of the system attracted many passengers but it has been the experience of the past that electrification encourages rail travel. The latest previous example was the conversion of the Kent lines in the Southern Region where a doubling of traffic has also occurred.

It was not sheer optimism on the part of the British Transport Commission which made it expect its modernisation plan to result in sufficient additional revenue to cover the heavy expenditure envisaged. Opponents of the continuance of electrification have expressed a great deal of doubt about future traffic but it is pretty certain that only electrification will enable the railways to approach solvency.

The unfortunate setbacks in the Eastern and Scottish Regions will temporarily halt the upward traffic trend but it is bound to be resumed when initial troubles have been overcome.

LEVEL CROSSING PROTECTION

Although it is hoped that eventually all rail-road level crossings will be replaced by bridges to reduce traffic hold-ups, this must obviously take some time. Meanwhile, many of the existing hand-operated swinging gate protective systems need to be replaced and Ministry of Transport approval has been given for the new gear to be of the lifting barrier type. One such installation has recently been made near Worthing station on the Southern Region of British Railways, and although not the first of its type in the country, it is the first in this Region and the first over a railway line electrified on the third rail system. The barriers meet the requirements of the relevant M.o.T. specification and although when the crossing is open to road traffic there is nothing to stop trespass on the tracks, the risk is not considered to be greater here than that already existing at other places. The break in the third rail can, of course, be made long enough to give adequate clearance from the road as no difficulty is presented to multiple-unit trains and electric locomotives have provision for crossing conductor rail gaps.

We are told that some 300 of these crossings will be installed in the Southern Region alone in the next two years, some manually controlled from an adjacent signal box as is the case at Worthing, and others automatically operated, the control being initiated, as with the signalling system, by the passage of the train over the various track circuits.

A symposium on the Dounreay fast reactor was held in London recently, under the aegis of the British Nuclear Energy Conference, at which the design, construction and initial operation of the reactor were described, together with some of the problems involved. The part that reactors of this type might play in an integrated programme of nuclear power producing reactors was also discussed

FAST REACTORS

By R. V. MOORE, G.C., B.Sc.(Eng.), M.I.E.E., M.I.Mech.E.*

A FAST reactor is one in which fission of the fuel is caused by neutrons of much higher energy (i.e. moving at higher speeds) than is the case in a thermal reactor. Thus one of the major differences between a fast reactor and a thermal reactor of the type currently being constructed for power production in the United Kingdom is the absence of a bulky graphite moderator for slowing down the neutrons. Reproduction of neutrons by fission of the fuel is greater for the higher energy neutrons, particularly in the case of plutonium, and, because non-fissile capture is particularly likely in an energy range intermediate between fast and thermal, the same loss of neutrons as occurs in a thermal reactor during the slowing down process does not occur in a fast reactor. Thus, fast reactors possess an improved neutron economy. Other factors, too detailed to discuss in this short article, enhance the neutron economy and it is this superior neutron economy which leads to the possibility of breeding more fissile material than is consumed.

A second advantage of fast reactors is that, because neutron capture by materials is inversely proportional to the neutron velocity, the choice of materials for use in the core becomes wider than for a thermal reactor. For example, the use of stainless steel in relatively large quantities is feasible economically.

However, to sustain a chain reaction in an unmoderated core, the ratio of fissile to fertile materials in the fuel must be much higher than for the current thermal reactors, and such fuel is expensive. It is, therefore, economically necessary to operate a fast reactor with a high specific power rating and this, together with the absence of a moderator, leads to a core of high power-to-volume ratio resulting in a small size for a given output. A small core results in an appreciable leakage of neutrons from its surface and to conserve as many as possible the core is surrounded by a blanket of natural or depleted uranium. This provides some measure of reflection, while neutrons captured in it transmute the uranium 238 into plutonium 239, a fissile material. In general, a significant contribution to the breeding ratio arises from this neutron capture.

The nuclear characteristics of a fast reactor make it particularly suitable for operating with plutonium, since all the isotopes, including those which are non-fissile in thermal reactors, are effective fuels. Furthermore, for a given output, less plutonium would be required for the primary fuel charge than if uranium 235 were used.

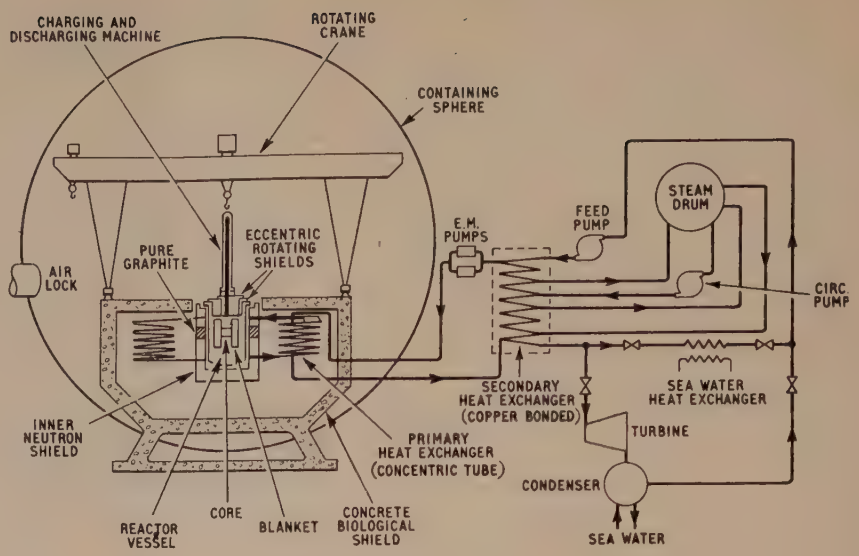
Fuel Costs

The major problems associated with fast reactors arise primarily from the need to use an expensive enriched fuel and the consequent high power density of the core. In order to keep down the fuel cost component of the total generation cost of electricity, it is important to minimise the amount of fuel in the irradiation-cooling-reprocessing cycle. The useful life in the reactor must be long compared with the time out of the reactor and the fuel must be able to sustain a high total burn-up. Thus a fuel element that is dimensionally stable to high burn-up under reactor conditions is a prime requirement. Among other properties, the fuel must have a high density, good compatibility with its canning material, and must be capable of fabrication and processing at a reasonable cost. Fuel in the form of pure or alloyed metal, ceramics such as oxide and carbide, and dispersions of suitable compounds in metallic matrices are being considered. None of these forms is ideal from all aspects and a considerable development programme, including irradiation experiments, will be necessary before the most suitable fuel for large-scale use can be selected. Much work will also be required on the chemical processing and refabrication of highly active fuels.

Because of the high power density of the core, the heat

* Deputy Managing Director (Projects), Development & Engineering Group, U.K.A.E.A.

removal problem in a fast reactor is considerably more severe than for the present thermal reactors. The inadequacy of gases as heat transfer media (because of the large power requirement for their circulation) suggested the use of liquids. By the very nature of fast reactors it was undesirable to introduce into the core any neutron moderating material, and water or hydrogenous material was therefore precluded. Thus attention was directed to the use of liquid metals and sodium and sodium-potassium alloys have emerged as pre-eminent. The properties of sodium which have led to its choice as a coolant for fast reactors are good resistance to irradiation damage and a high boiling point, which permits high operating temperatures and high efficiency in the steam cycle. The low vapour pressure at working temperatures enables system pressures to be kept relatively low. Sodium also has a high thermal conductivity and reasonably high specific heat and density which enable the required heat transfer rates to be obtained with acceptable coolant velocities and temperature rise. Finally, it is cheap and readily obtainable in bulk supply.

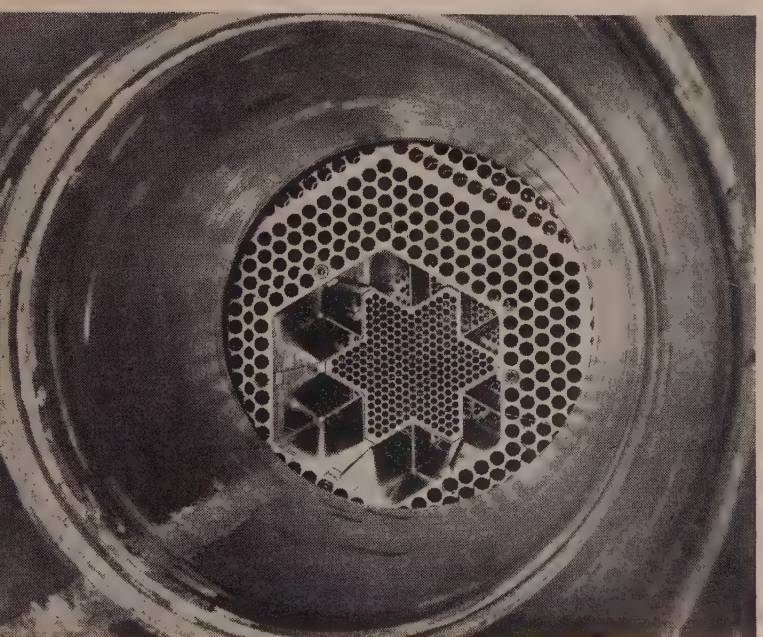


Schematic arrangement of the fast reactor plant

Sodium is not, of course, ideal and a number of limitations have to be accepted. The freezing point (98°C) is above ambient temperature and arrangements to maintain the whole system above this temperature at all times are necessary. The freezing point of the more expensive 70/30 per cent (by weight) sodium-potassium alloy is somewhat lower, but the heat transfer properties are inferior and it is more reactive with water and air. Under irradiation, sodium becomes highly active and circuits must be heavily shielded. The level of impurities, such as carbon, hydrogen and oxygen, must be kept low (say < 10 p.p.m.) to avoid compatibility difficulties and the danger of plugging of parts of the circuit due to the low solubility of sodium monoxide. Sodium and water react violently together, and, to a lesser extent, so do sodium and steam. Special precautions therefore have to be taken in the steam raising plant to avoid a hazard arising from, say, a tube failure.

Although sodium technology has been rapidly built up over the past decade, much has still to be learned.

View through the shield showing core top plate and the twelve control rod carriers. The breeder supports can also be seen



Method of Control

Control of a nuclear reactor is effected by changing the balance between neutron production and loss by varying the non-fissile capture or the leakage of neutrons. Thermal reactors are usually controlled by absorption, but for fast neutrons there are no highly absorbent elements, and up to the present fast reactor control has been effected by neutron leakage. For very small reactors movement of the reflector has been used but the more common method has been to move fuel in and out of the core. The trend is towards larger cores for power producing fast reactors. A lower leakage of neutrons results, and permits the use of a lower enrichment for the fuel. This produces a softer neutron energy spectrum and control by absorber becomes more feasible. Movement of the amount of fuel necessary for control becomes unwieldy as core sizes increase, and control of future power reactors is likely to be by a combination of both methods.

Fast reactors possess a reactivity characteristic not evident in a large reactor, in that slight movements of fuel within a small core become relatively important. Such movements can arise from the bowing of a fuel element due to a temperature gradient across it and it is necessary to design so that the permissible movement is limited or provides a stabilising effect.

After a reactor has been shut down fission products within the fuel will decay with the production of heat. In the small core of a fast reactor this heat must be removed continuously by the coolant if high temperatures, leading to melting of the fuel, are to be avoided. It is possible that, if the fuel melts, a critical assembly of fuel could reform within the core structure. The prevention of this

constitutes a major design problem with fast reactors and extensive precautions have to be taken to avoid loss of coolant or interruption of coolant flow.

Fast and Thermal Reactors

Having discussed the characteristics of fast reactors generally, it is appropriate to show how this type of reactor could fit into an integrated nuclear power programme. The principal target for such a programme must be the production of electricity at a cost competitive with the fossil fuels, while a secondary target is the full utilisation of all nuclear fuel resources. A substantial installation programme of nuclear power stations based on natural uranium thermal reactors has already been started in the United Kingdom; indeed the first two of these stations are due to be commissioned during 1961. By 1970 the country will be a large producer of plutonium and during the early 1970's there should be available sufficient stocks to underwrite the operation of the first of a system of large output fast breeder reactors.

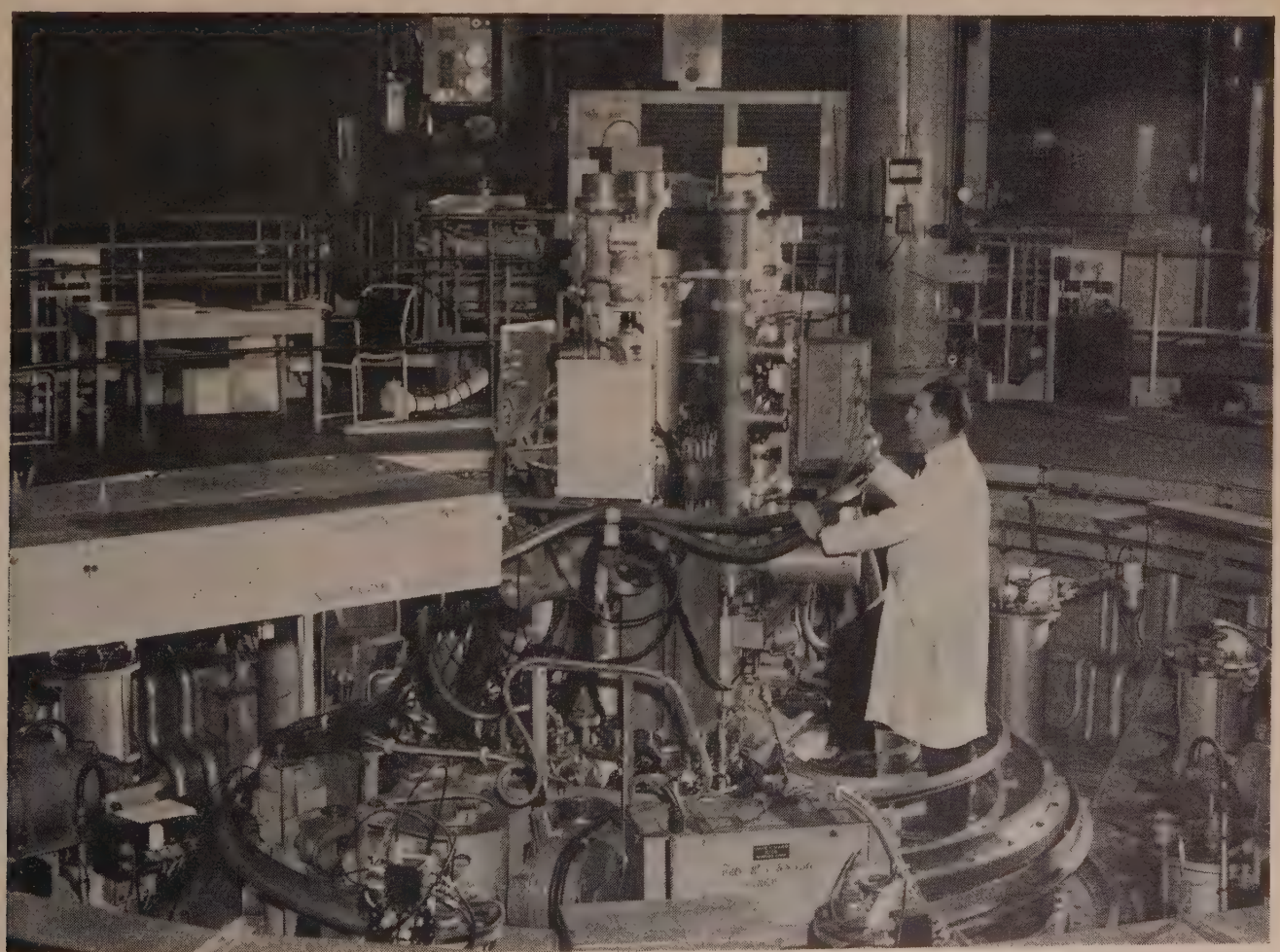
From the fuel cycle point of view a fast reactor is an efficient user of plutonium and appears to be a very suitable complementary plant to the natural or slightly enriched uranium thermal reactor. The ratio of fast to thermal reactors built depends on the rate of annual installation but it seems likely that the commissioning of thermal reactors will continue, though on a reduced basis, even after the commissioning of the first few large fast reactors. Such a system would be able to make inroads into the abundant uranium 238 resources. Because of the potential advantages of fast reactors of low capital and fuel cycle costs, the attainment of the first target of competitive generation costs could stem from the achievement of the secondary target.

However, before large fast reactors could be contemplated for such a programme, major advances from the Dounreay fast reactor (D.F.R.) must be made. Indeed, it is highly likely that a prototype large reactor will have to be designed, built and operated. The first stages of such a project have already begun and the experience gained with the operation of the D.F.R. will play a vital part in the overall programme.

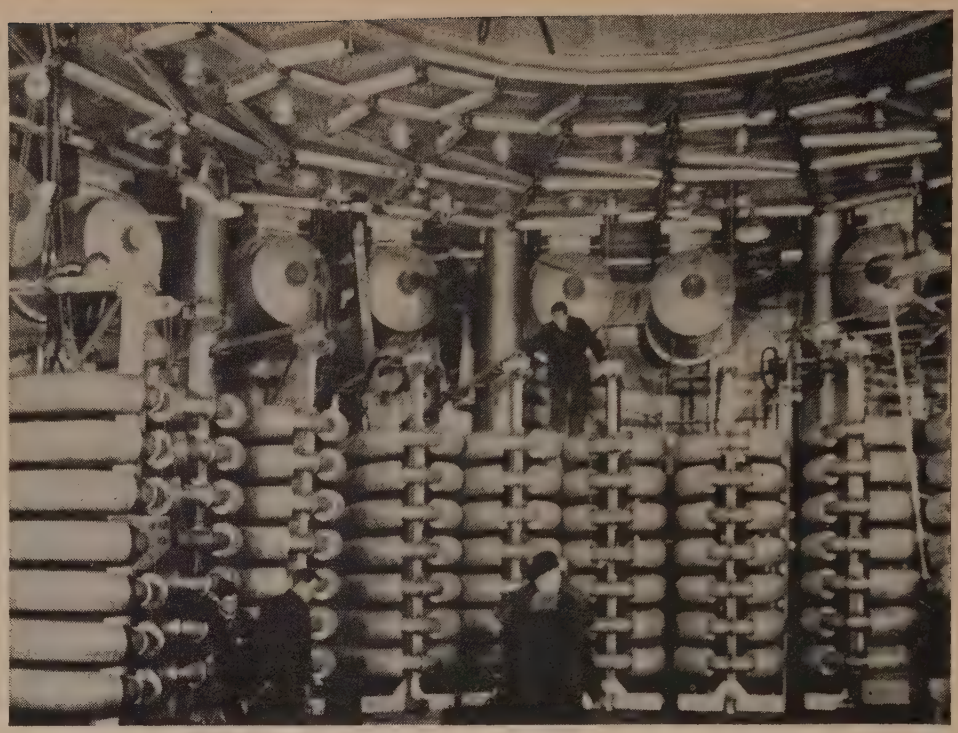
Construction of the D.F.R. commenced in 1955 and the reactor became critical for the first time in November, 1959. It was operated at low power until April, 1960, when it was shut down for the replacement of the core by one of modified design to facilitate the irradiation testing of fuel assemblies for a prototype reactor.

The plant has been designed for a maximum rating of 60 MW(H) from the core and 12 MW(H) from the breeder using the 70/30 per cent (by weight) sodium-potassium alloy as coolant, but it has been estimated that these figures could be increased to 85 MW(H) and 15 MW(H) respectively by using sodium which, it is anticipated, will replace the alloy in due course. The fuel used in the core is enriched uranium in metallic form, the 367 fuel elements being

Fast reactor top showing control gear in operating condition



annular in section. The outer sheath is made from niobium and the inner tube from vanadium and the element is filled with sodium to act as a heat transfer medium between fuel and sheath. The core and breeder blanket are contained within a stainless steel vessel and heat is removed in 24 primary coolant circuits, the temperature of the coolant being raised from 200°C to 350°C. The heat is then transferred in the primary heat exchangers to 12 secondary coolant circuits containing sodium-potassium, which in turn transfer the heat to the secondary water heat exchangers. The liquid metal in both primary and secondary circuits is circulated by electromagnetic pumps. The reactor and the whole of the highly active primary circuits, together with the associated shielding, is contained within a large steel sphere which is sealed from the outside atmosphere. Access to the inside of the sphere is through an airlock. Control and shut-down of the reactor is effected by movement of groups of fuel elements, while for emergency use, three boron-10 neutron absorbers are available for insertion into the inner breeder region.



Installation of primary heat exchanger coils and electromagnetic pumps in fast reactor vault

The main purpose of the Dounreay fast reactor in the future may be summarised as follows:

(a) To explore the operating and safety characteristics of this class of reactor.
(b) To examine its kinetic behaviour.
(c) To provide a fast neutron flux irradiation facility for the development of fast reactor fuels and structural materials.
(d) To further the development of liquid metal circuits.
(e) To investigate generally problems associated with the use of plutonium-based fuel.

A plant as revolutionary as the Dounreay fast reactor may be expected to yield experience which could add significantly to our knowledge of reactor technology.

FUEL CELLS

A COMPREHENSIVE study of fuel cells has just been published by the Fuel Cell Research Associates of the U.S.A. This book, entitled "Fuel Cells: Power for the Future," presents an economic and technical analysis of developments in the field of electrochemical fuel cells. The book has been written by nine students at the Harvard Business School who spent almost one year interviewing leading scientists in the field, reviewing current papers on fuel cells, and analysing the activities of companies doing fuel cell research.

Fuel cells are sources of power which convert chemical energy of fuels (for example, hydrogen, propane) directly into electrical energy at efficiencies of 50 to 85 per cent. The 160-page illustrated report states: "The fuel cell is definitely not in the class of exotic power sources and should soon play a major role in industry."

At present, there are several fuel cells being considered for commercial application and the study presents analyses of predicted short- and long-term fuel cell developments. Excellent results are being obtained with fuel cells using hydrogen and oxygen. The report states, however, that before fuel cells are widely accepted in conventional power applications, use of less expensive fuels such as hydrocarbons (propane, ethane) and air will have to be achieved.

The book can be obtained from the publishers at P.O. Box 157, Cambridge 38, Massachusetts, U.S.A. It costs $18.75.

Sir John Cass College

COURSES commencing in the New Year at the Sir John Cass College, Jewry Street, Aldgate, London, E.C.3, include the following:—Experimental Techniques in Physics (Thursday evenings from 12th January, for ten weeks); Statistical Methods in Scientific and Industrial Research (twelve lectures on Monday evenings from 2nd January); Patents and Industrial Design Protection (eight lectures on Thursday evenings from 12th January); Trade Marks (four lectures on Thursday evenings from 27th April); and Electronic Computing Systems, Part II (twelve lectures on Wednesday evenings from 18th January).

VIEWS on the NEWS

By "REFLECTOR"

MR. Alfred Robens, the chairman-designate of the National Coal Board, told members of the mining industry last week that by the 1970's half the Board's production would be going to power station boilers. According to *The Guardian*, Mr. Robens went on to say that the Board would have to give a better service to industry, supplying the fuels wanted and providing such other services as the removal of ashes. I am quite sure that Mr. Robens did not mean that this removal service would include power station ash, but how welcome such a departure would be to the Central Electricity Generating Board.

* * *

Either the Christmas illuminations at Tonbridge are on a colossal scale or there has been a falling-off in the town's load. The *Evening News* says that "the electricity loading is equal to that of the normal loading for the whole town." The cost is said to be £1,440 which seems to be very reasonable.

* * *

Christmas illuminations in Brussels were inaugurated last week by the Lord Mayor of that city. When it came to switching on he said: "*Fiat lux!*" but, says *The Guardian*, nothing happened, nor did the lights come on when he repeated it.

> "Then he added in French: 'Let the lights go on'—and the streets became a blaze of light. 'How were we to know it was Latin?' said an electrician later. 'We thought he was talking about motor-cars or soap flakes.'"

* * *

"Peterborough" in the *Daily Telegraph* has come across a postcard sent to a Newbury reader by the Southern Electricity Board to tell him that his supply would be interrupted while certain work was being done. The postcard bears the post-mark slogan: "Electricity makes life easier."

* * *

The mast on the Kent side which will carry the super-grid over the Thames is 630ft high and so on a clear day an extensive panorama will be available from the summit. An opportunity to enjoy this view has been offered to the members of the Swanscombe Council by the Central Electricity Generating Board. The chairman has said that he would certainly like to accept the invitation but, says the *Gravesend & Dartford Reporter*, the enthusiasm of other members appears to be not so keen. No doubt they feel that local councillors should keep their feet on the ground and their heads out of the clouds.

* * *

A proposal to increase the street lighting in part of the Bolton area by fitting extra mantles to the gas lamps is described by the *Bolton Evening News* as "about as ineffectual a plan as was ever conceived." Gas lamps, it is said, have long been jettisoned by progressive authorities but Bolton has turned down a 20-year plan to replace them by electric lamps as a luxury that could not be afforded. Yet in the long run there would be a saving to the town. The *Bolton Evening News* may be consoled by being told that even in the heart of London gas lighting still persists.

* * *

An article on "Long Distance Heavy Electric Railways" was contributed by Rankin Kennedy to the *Electrical Review* of 21st December, 1900. I quote the opening paragraph which is of particular interest at the present time:—

> "This subject is becoming almost fascinating. The tendency seems to be towards a three-phase system for the sake of easy transforming. But the three-phase motor is not controllable sufficiently easily as to speed, hence the proposal requires the use of rotary converters. These are all right, but introduce great cost and attendance at sub-stations. The best system seems to be an alternating primary supply, it matters little whether it is single-phase or multi-phase, at a very high pressure, 20,000 volts or more, feeding stationary transformers, along the line 10 to 1 ratio, a secondary overhead trolley wire at 2,000 volts, feeding a locomotive carrying two rotary converters converting the 2,000 volt alternating to 400 or 500 volt continuous, this 500 volt continuous to work motors on each locomotive axle by ordinary controllers. Or even 100 volt continuous might be used, and 50 large storage cells carried on each locomotive, capable of moving without the trolley, while these cells could be kept charged from the converter. The converter should be a very high speed synchronous motor connected to a continuous current generator."

* * *

Once again I extend my best wishes for Christmas and the coming year to all my readers, particularly those who have suggested subjects for comment, or have commented on my comments, during 1960.

AN ALL-ELECTRIC UNIVERSE

As a result of more than 20 years' work, initially in connection with lightning, switchgear and other arcs, the author has proposed a theory of the evolution of the universe, which will be of interest to electrical engineers. He endeavours to show that electrical discharges have gradually condensed matter from the primordial gas and dust of a general universal atmosphere, first into galaxies, then from the condensed matter of the galaxies into stars. Discharges in the extended atmospheres of stars further condensed the matter, ultimately to allow the formation of planets and satellites

IN a letter to an inquiring friend in 1755, Benjamin Franklin wrote: " I wish I could give you any satisfaction in the article of clouds. I am still at a loss about the manner in which they become charged with electricity; no hypothesis I have yet formed perfectly satisfying me." Over 200 years later, no generally accepted theory for the electric charge generation in thunderstorms has yet been put forward. However, in a paper in the *Philosophical Magazine* in 1955 the writer put forward a hypothesis to account for the separation of electrical charges in the terrestrial and cosmical atmospheres which derives directly from the first recorded electrical experiment.

We were all taught that two bodies could be electrified by being rubbed together, but that they should be of *different* materials. It was only as recently as 1926 that Prof. P. E. Shaw showed that this is an unnecessary limitation, and that if there be asymmetry in the interaction between two pieces of the *same* material, then they will become oppositely charged. For example, if a limited section of one rod be rubbed along the whole length of a similar rod, the two will be oppositely charged as a result. Shaw also showed that powders of the same material become electrically charged when they are blown about, and that the effect with dry ice particles is of the same order as that observed with similar particles of sand. Since we know that in sand and dust storms, and in the ejectamenta from volcanoes, electric fields are built up until breakdown occurs in air at atmospheric pressure, this gives a clue to the building up of terrestrial and cosmic atmospheric electric fields. The resultant breakdown can account for many of the visible phenomena throughout the universe.

In our atmosphere the discharges may last for seconds, in stellar atmospheres for years, and in galactic atmospheres for tens or hundeds of millions of years, while on a still grander scale they may originally have enveloped the whole universe as we know it. This was the view of universal evolution, first put forward by the author in 1944: that electrical discharges have gradually condensed the matter from the primordial gas and dust of a general universal atmosphere, first into the galaxies, then from the condensed matter of the galaxies into stars. Discharges in the extended atmospheres of stars further condense the matter ultimately to allow of the formation of planets and satellites.

The idea of the aggregation of the gaseous matter of the atmospheres by electrical discharges was merely a hypothesis, which seemed essential to account for the observations. However, in 1956 the writer emphasised that associated with these electrical discharges is the most powerful mechanism of aggregation known. When this is operative, as it is in the welding arc, it reduces the relative effect of gravitation to negligible proportions. This discovery has been mainly responsible for the transformation of the new view of universal phenomena from a hypothesis into a soundly working theory. It amply fulfils the fundamental requirement of a satisfactory theory, in that it has led to the making of some seemingly fantastic predictions—and they have come off! For example, it enabled the deduction to be made in a contribution to last year's I.E.E. convention on thermonuclear processes that the temperature in solar atmospheric electric discharges must reach values of about 100,000,000°K. That was surely sticking one's theoretical neck right out, since the highest known temperatures were the million degrees or so observed in the solar corona. However, later last year, the U.S. Navy published the results of their observations made during solar flares by satellite-borne instruments, and reported the existence of 80,000 V X-rays and therefore, temperatures of 100,000,000°K.

Outline of the Theory

There are four major aspects of the theory to be considered:—

(1) The building-up of cosmic atmospheric electric fields;
(2) The breakdown of these fields in electrical discharges;
(3) The gathering of the atmospheric matter along the discharge channels;
(4) The production of jets of hot gas as a result of the preceding process.

" Where gas collects, grains collect " wrote van de Hulst, and he went on to enumerate the effects of the grains, but omitted to say that they become charged on impact. If a saucerful of powder is blown into the air, one can soon detect the presence of electric fields all over the room. As with so many apparently simple processes it is impossible to determine precisely how this happens, and what physical processes are involved in the phenomenon of charge separation on impact. However, we know it happens, and we know also that in sand and dust, and thunderstorms, electric fields are built up until breakdown of air at atmospheric pressure occurs. Furthermore, knowing roughly the time scale of the phenomena in terrestrial thunderclouds, and allowing for the changes in the main physical parameters involved (gas density,

By C. E. R. BRUCE
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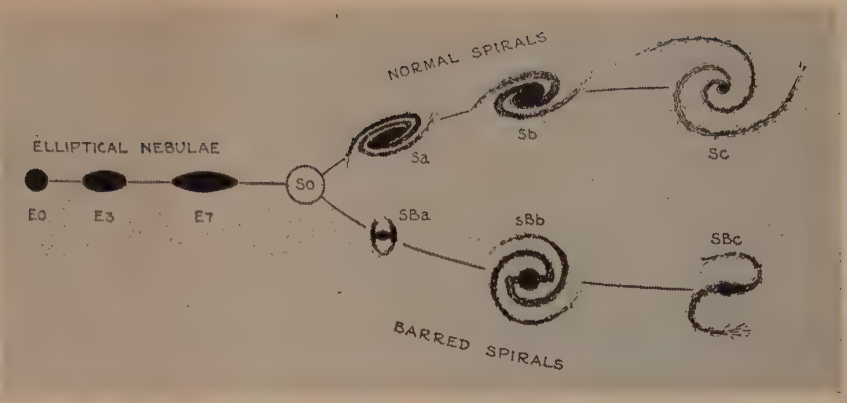

Fig. 1.—Hubble's scheme of extra-galactic nebular evolution

gravitational force, and particle velocities) one can estimate roughly the time scale of the phenomena in stellar thunderclouds.

Arguing on these lines, the terrestrial thundercloud itme scale of 10^2 sec would become 10^6 to 10^9 sec in the atmospheres of the long-period variable stars. The factor of uncertainty of 10^3 is unavoidable, since this is the ratio of the two velocities involved, and it is still uncertain from experiments whether the charge generated is proportional directly to the particle velocity or its square. The periods of these variable stars, the red or long-period variables, in which the writer has suggested thunderstorms cause considerable periodic increases in luminosity, actually lie between 10^7 and 10^8 sec. This agrees with the theoretical estimate as well as can be expected.

There is another check on the time scale, since the velocity of propagation of electrical discharges should be independent of the gas density, depending, as it does, on the product of the breakdown potential, which is proportional to the gas density, and the molecular mean free path, which is inversely proportional to it. The dimensions of these stellar atmospheres lie between 10^{14} and 10^{15} cm. Since the velocity of propagation of the breakdown process at atmospheric pressure lies between 10^7 and 10^8 cm/sec, these two figures again yield a value of about 10^7 sec for the duration of the discharges, and hence of the periods of enhanced light, so that the electric field and discharge theory leads to results which are in good accord with observation so far as the time scales of these stellar outbursts of increased luminosity are concerned.

Cosmical Electrical Discharges

The evidence in favour of the electrical discharge theory is overwhelming. The circumstances are often analogous to those existing in the earth's atmosphere, in which, during thunderstorms, we observe the sudden appearance of light indicating the existence of temperatures of 50,000°K to 100,000°K in a gaseous atmosphere at about 280°K. Similarly in the extensive and otherwise cold atmospheres of the long-period variable stars whose "surface" temperatures only reach 1,500°K to 4,000°K, there suddenly arises light which can only come from gas at 5,000°K or 10,000°K up to nearly a million degrees. It is certain that this light originates somewhere between the star's photosphere at, say 2,000°K, and the outer regions of the atmosphere, in which the temperature is so low that molecules of titanium oxide exist, which dissociate at just over 1,500°K.

If the astrophysicist is granted the existence of cosmic *magnetic fields* he can explain the origin of cosmic radio waves, *if* the existence of *relativistic electrons* is assumed. So far he has no clue as to where to look for the origin of either, for magnetic fields and electrons travelling with speeds approaching that of light do not grow on cosmic gooseberry bushes, so to speak. However, they *both* do occur in cosmic electrical discharges, because the author has shown that the temperatures in these discharges can reach values of 400,000,000°K, at which even the *average* velocity of the electrons reaches about two-thirds that of light.

Aggregation of Matter

Another major problem in astrophysics is that of finding an explanation for the aggregation of matter, such as is observed in the spiral arms of our own and other galaxies. This has proved so difficult that there has been a growing tendency in America to reverse Hubble's scheme of galactic evolution, and to suppose that the late type spirals are really early type nebulæ, and the matter in the spiral arms gradually disperses to form the elliptical nebulæ at the left of Fig. 1. Attempts are even made to suggest that Hubble did not regard that diagram, taken from his book, "The Realm of the Nebulæ," as indicating the direction of nebular evolution. So far it has proved impossible to account for this aggregation of matter along filaments on a gravitational basis.

The situation was admirably summed up by a speaker at the International Astronomical Union's Third Symposium on Cosmical Gas Dynamics held at Cambridge, Mass., in 1957. He was asked to comment on the nonplaneness of the galaxy, which he had referred to as a possible tidal effect, and whether an explanation could be given in terms of gravitational interaction with the Small and Large Magellanic Clouds. The speaker replied by saying that ". . . the distortion observed . . . is too large by about two orders of magnitude to be explained by gravitational effects. But really I am not surprised. We see such enormous distortions in many galaxies, and bridges between galaxies, and also more fancy things which cannot possibly be explained by gravitation, neither in order of magnitude nor even qualitatively in shape."

Fig. 2 shows one of the "fancy things," which the speaker probably had in mind. It is well known that currents will flow along and not across any magnetic fields

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they encounter in cosmic space. If currents flowed round the spiral arms or discharge channels of the nebula on the left, while the discharges were in progress in the nebula on the right, then the currents in the latter would tend to flow along the magnetic field due to the former, and account for the " right-angled turns " taken by the two discharges in the nebula on the right.

A more homely example of the " outclassing " of gravitational forces by the electrodynamic ones deriving from electrical discharges, affords the physical basis of the arc welding process, as was demonstrated a few years ago in the E.R.A. Laboratories. The charged conducting particles, electrons and positive ions, as they carry the current, move in the discharge's own magnetic field, and by it are constrained to move in towards the axial regions of the arc.

Fig. 2.—Interacting galaxies

The result is an axial increase in gas pressure, which is proportional to the product of the current and the current density. If either of these quantities varies, a pressure gradient, and hence a flow of gas, will be set up. In the arc discharge the current is constant, but the current density increases greatly at and towards the electrode hot spots. The steep pressure gradients at each of these, which further depend on the polarity and form of the electrodes, give rise to the anode and cathode jets. These jets of hot gas entrain the metal droplets, as they are nipped off the end of the welding rod, and carry them over to the job, as King showed in these Laboratories. The reality of this process was demonstrated by high-speed photographs taken by Needham. The single frame (Fig. 3) shows the tail of metal vapour blown *ahead* of the droplet towards the metal being welded. The process is therefore entirely independent of gravitational forces, as every welder knows.

This same force has collected the atmospheric gas of extra-galactic nebulæ and transformed objects like that shown in Fig. 4 (a) into objects like that in Fig. 4 (b). In these stellar and galactic atmospheric discharges both the current and the current density decrease outwards, resulting in a pressure gradient along the discharge channel. This same " magnetic hose-pipe " effect associated with electrical discharges in the sun's atmosphere, squirts jets of highly ionised gas of that atmosphere past the earth and causes magnetic storms during solar outbursts.

Gas-Velocity Thermometer

The velocity of the gas along these " magnetic hose-pipes " formed by electrical discharges cannot increase indefinitely, but will be limited by the velocity of sound in the gas at the temperature existing in the axial regions of the discharge. This fact enables us to determine its velocity if we know its temperature, and, conversely, its temperature if we know its velocity. We can measure the velocity from the Doppler shift of the lines in its spectrum, caused by the motion of the emitting gas in the line of sight. As the nature of these spectrum lines indicates the gas temperature, the recordings of the " gas-velocity thermometer " can be checked over a wide range of temperature, say from 5,000°K to over a million degrees absolute. Beyond that simple theory enables us to extend the range up to about 400,000,000°K.

In the lightning discharge we know the gas temperature from laboratory studies of high current arcs newly formed in cold gas, and at currents of 10,000 A to over 200,000 A these temperatures will lie between 50,000°K and about 100,000°K. The gas velocity will therefore be the velocity of sound in ionised and dissociated air at these temperatures, or about 5 to 10 km/sec, while the times involved in the high current pulses are 100 μsec to 1 millisec. During these discharge periods material vaporised at the earth's surface will be carried for distances of half a metre to ten metres along the lightning channel by gas jets having the velocities calculated on the basis of the gas velocity thermometer. These considerations explained the observation that metal lines appear in the spectrum of the lightning discharge up to heights of about two metres above the ground.

As with the process of electric field generation, so the first extra-terrestrial application of the gas-velocity thermometer was to the gas movements engendered by the electrical discharges in the atmospheres of the long-period variable stars. Previously there has been no generally accepted explanation either for the sudden appearance of the bright emission lines in the spectra of these extensive cold long-period variables, or for the fact that the hot gas, at 5,000° to 10,000°K, is thrown outwards in the stars' atmospheres. From the spectra of the outbursts it can be deduced that gas is mainly ionised hydrogen at these temperatures. Thus the gas velocities predicted by the theory lie between 8·5 and 12 km/sec which is a very narrow range. The average gas velocities actually observed in two groups of these stars at Mount Wilson Observatory are 9 and 11 km/sec respectively.

One of the observers found that a similar type of star showed a gas velocity of 110 km/sec, and this caused considerable consternation because the velocity of sound only increases as the square root of the gas temperature. This means that the temperature of some of the gas in the extensive cold atmosphere of that star, AX Persei, suddenly is raised to half a million or a million degrees, if the theory is correct. But of course the theory is correct! And to prove it two other workers found in the spectrum of AX Persei, lines emitted by iron atoms which have been " knocked about a bit," and in the process lost 5, 6 and even 13 elec-

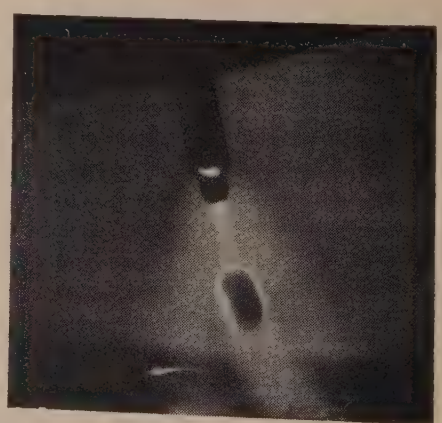


Fig. 3.—High-speed camera photograph of the welding arc

trons. The temperature necessary to effect this is, as you have already guessed, half a million to a million degrees!

To check the readings of the gas-velocity thermometer up to a further two powers of ten in temperature, we consider what happens when the discharge temperature reaches the value sought after in physical laboratories. If thermonuclear processes are initiated then the increase in energy, and hence gas pressure due to this source, will balance the tendency of the electromagnetic forces to compress the gas. One would thus expect a limiting temperature to be reached between 10^8 and 10^9 °K, at which these processes may be expected to commence in cosmic gas. At these temperatures the velocity of sound in ionised atomic hydrogen lies between 1,750 and 5,400 km/sec. An observer at Mount Wilson has studied the bright emission patches observed in extra-galactic discharges. The broadening of the spectrum lines indicates that the gas velocities in these patches lie between 1,840 and 4,500 km/sec, in good agreement with the theoretical estimates.

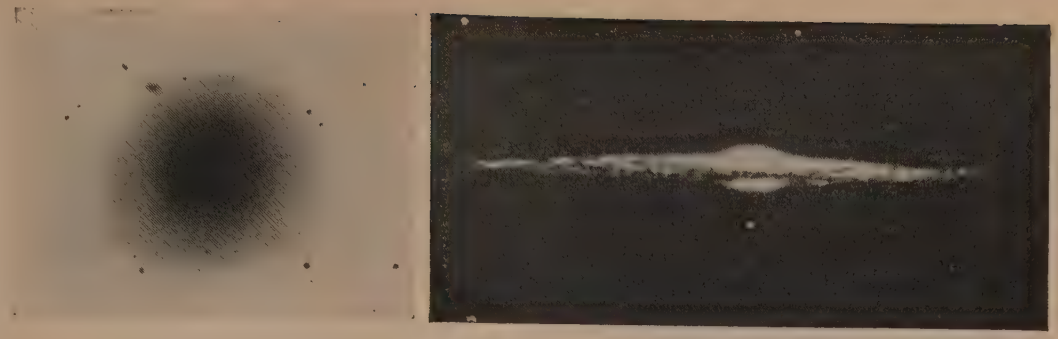


Fig. 4.—Photographs of (a) a globular nebula and (b) a late-type spiral nebula seen end-on

Magnetic Storms

It was a belief in the "readings" of the gas-velocity thermometer which led to the prediction or deduction that, somewhere between the sun and the earth, temperatures of about $10^{8°}$ occur in electrical discharges in the solar atmosphere. For during magnetic storms and auroræ particles are observed entering the earth's upper atmosphere at velocities of up to 3,500 km/sec. It followed at once that these indicated the existence of temperatures over 10^8 °K. Within a few months of this challenging deduction being made, it was verified by satellite observations in the United States.

The author's theory corrects erroneous assumptions often made about the nature of these jets, which for the last 64 years have been postulated as the cause of magnetic storms, though hitherto no one has had a clue to offer as to their origin. Their average velocity (about 2,000 km/sec) is known from the time interval between the observed solar outburst and the ensuing magnetic storm, and it has been freely taken for granted that this velocity can be associated with quite different internal characteristics of the jet. This is physically impossible. It was assumed that, if the jet comes from the region of the sun's photosphere, it will have one density and temperature, and if it originates in the region of the solar corona, it will have other and quite different conditions of density and temperature.

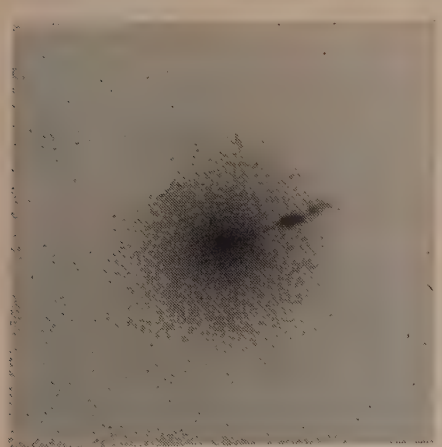


Fig. 5.—Enlargement of the central regions of Fig. 4 (a)

But these views have always and admittedly faced three major difficulties. What causes the jet in the first place? How does it get out through the relatively dense inner solar atmosphere? How is it that it not only gets out but is actually accelerated from the highest velocities of 600 or 700 km/sec observed at the sun's surface, to an average velocity of 2,000 km/sec, and a final velocity of up to 3,500 km/sec at the earth's orbit. These questions are answered by the electrical discharge theory, although the surprising conclusion is that the temperatures in these solar discharges must reach about 100,000,000 °K. However, the more surprising the deduction from any theory, the stronger is the support it affords for the truth of the theory when it is proved to be true, as this one has been.

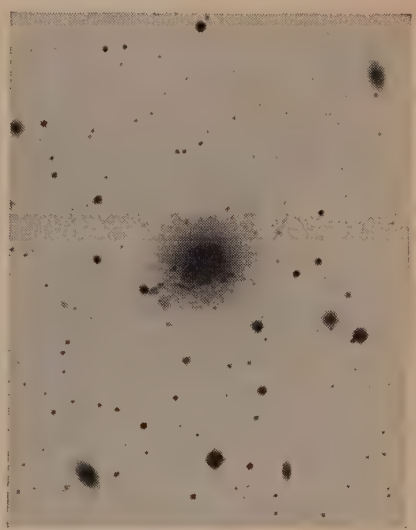


Fig. 6.—Photograph of the cosmic radio source NGC1275

Cosmic Radio Sources

In 1944 the first account of the discharge theory contained the equally surprising deduction that electrical discharges occur on a galactic scale in the atmospheres of globular nebulæ, such as NGC4486 shown in Fig. 4 (a). It was suggested that the occurrence of these galactic discharges transformed this type of globular or elliptical nebulæ into spiral nebulæ like that seen end-on in Fig. 4 (b). NGC4486 is in fact the well-known radio source Cygnus A. Careful filtering of its light at Mount Wilson, to see if it contained any special features, enabled the enlargement of its central regions (Fig. 5) to be obtained. This confirms the expectations of the discharge theory and shows that NGC4486 is a nebula in which electrical breakdown is in its early stages, the discharge being a mere 6,000 British billion miles long,

and about one tenth as wide! So another equally surprising deduction had an equally surprising verification.

Fig. 6 is another well-known radio source, NGC1275. This, following the suggestion made originally at Mount Wilson, is generally assumed to be the result of a collision between two galaxies, since the gas in the "arms" is moving at a velocity of 3,000 km/sec relative to the background gas. However, the writer has suggested that the arms are discharge channels and that this relative velocity is also the result of the discharge. It is certainly of the same order as those observed in the bright emission patches of other nebulæ.

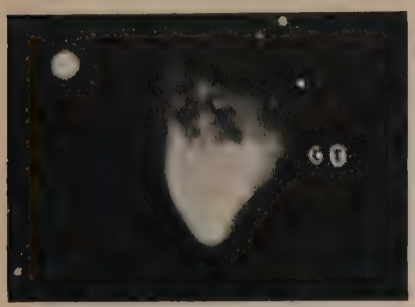


Fig. 7.—Photograph of Hubble's variable nebula

The theory should thus have the effect of ending the "solution by postulation," which exists in radio astronomical literature, for, in effect, all theoretical papers and lectures on the subject of the origin of cosmic radio noise open with the two postulations "Let H = the magnetic field; and let mc^2 = the energy of the relativistic electrons," the origin of both being quite unspecified and unknown. Indeed in one recent account of the "jet" in NGC4486 (Fig. 5) by two reputable astrophysicists, the following passage occurs: "Astrophysicists have been at a loss to account for its extremely strong radiation, and it is tempting to suppose that the energy is coming from the galaxy's capture of a gob of anti-matter coming from an anti-galaxy." The nature of this suggestion underlines the difficulties which these observations present to existing astrophysical theories. It is surely a much likelier solution that thermonuclear processes are being engendered in this successful cosmic "Zeta."

As regards the two fundamental requirements of current theories of the origin of cosmic radio noise, magnetic fields and relativistic electrons, the current in the discharge will obviously account for the first. As regards the second requirement, since the temperature in these galactic discharges reaches 400,000,000°K, the hydrogen atoms have velocities of over 4×10^8 cm/sec, so that the *average* velocity of the electrons reaches about two-thirds the velocity of light, and individual electrons will have still higher velocities. The theory therefore supplies both the essentials of the synchrotron theory of the origin of the radiation first developed by Shklovsky in 1955.

Spiral "Stellar" Nebulæ

Fig. 7 is a photograph of Hubble's variable nebula, and on the discharge theory this is a star in which the gas and dust of its extensive atmosphere have been collected together by an old nova discharge, just as the matter in galactic atmospheres has been collected along the spiral arms. In this cloud of gas and dust thunderstorms are practically continuous, just as they are in the upper regions of a terrestrial tornado, and account for the variability of the star's light. If one of these stars is seen end-on with the cometary nebula pointing towards us, then the bright emission lines to which these stellar lightning flashes give rise are emitted by gas which is being squirted out in our direction, and will therefore be displaced towards the violet. This is in accordance with the observations made on many such stars.

However, there are many stars in which each of the bright emission lines is split in two, one component being displaced towards the violet, and one towards the red end of the spectrum. This could obviously be explained if in these stars there had been two major and diametrically opposed discharges, such as there always are when the corresponding phenomenon occurs on a galactic scale, and results in the formation of the two spiral arms of the extragalactic nebulæ. Since at least one star had been photographed with a single discharge channel, it seemed highly probable that photographs should exist with two diametrically opposed nebulæ attached to the stellar nucleus.

Reference to a paper published 42 years ago at Lick

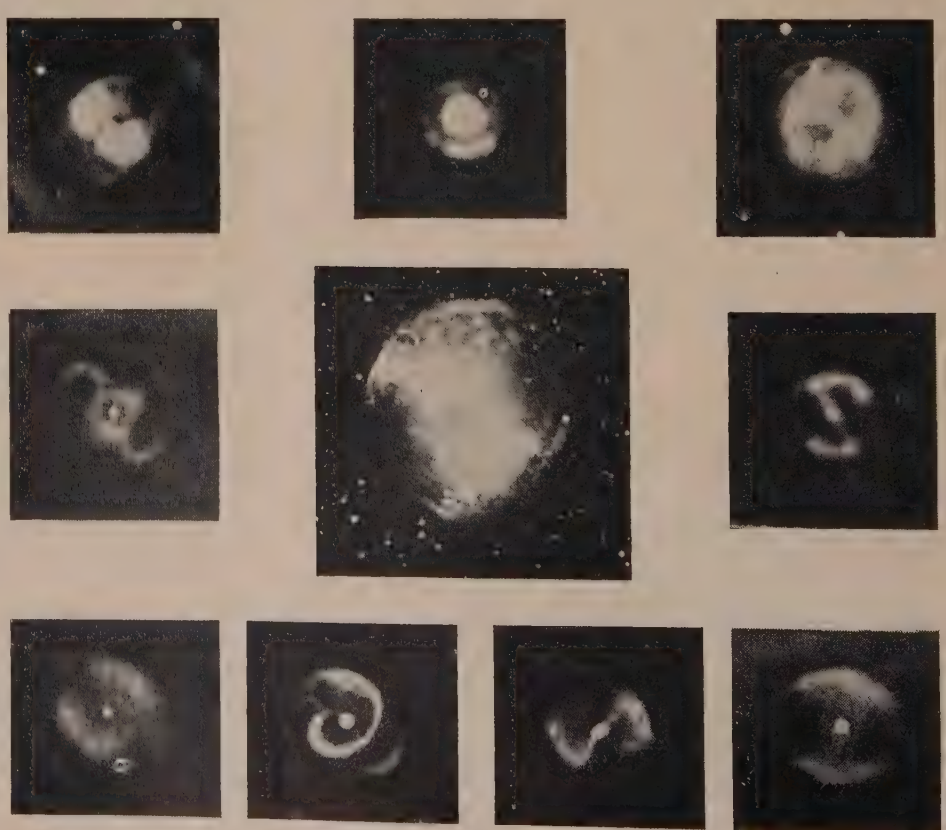


Fig. 8.—Photographs of planetary nebulæ

Observatory (Fig. 8) shows a profusion of such "two-armed" stellar nebulæ as the theory had predicted should exist. Perhaps the most exciting thing was the discovery that, as the photographs show, these stellar discharges sometimes take on a spiral, or a barred-spiral form, just as happens in all but about one per cent of galactic discharges.

At the same time as the photographic study was made at Lick Observatory, the gas movements in these same planetary nebulæ were deduced from their spectra, and proved in many cases quite inexplicable on any of the many hypotheses tried. However, as a forthcoming paper in the Journal of the Franklin Institute will show, they too are at once explained by the discharge theory, as resulting from the two jets of gas initiated in and by the two discharges.

Acknowledgment is due to the Electrical Research Association for the loan of the photograph used as Fig. 3, to the Lick Observatory for Fig. 8, and to Mount Wilson and Palomar Observatories for the remainder of the illustrations.

Short-Circuit Ratings for Power Cables

By R. G. PARR and G. S. BUCKINGHAM

Summaries of two papers read before a meeting of the Supply Section of the Institution of Electrical Engineers on 14th December. The first paper, by L. Gosland, B.Sc., M.I.E.E., and R. G. Parr, B.Sc.(Eng.), A.M.I.E.E., was entitled "A Basis for Short-Circuit Ratings for Paper-Insulated Cables up to 11 kV." The second paper submitted was prepared by G. S. Buckingham, B.Sc.(Eng.), D.F.H., M.I.E.E., whose subject was "Short-Circuit Ratings for Mains Cables"

THE short-circuit rating of paper insulated cables is usually based on a maximum conductor temperature of 120°C. Substantial savings could be made by an increase of this limit, which operational experience has proved to be conservative. Investigations have shown that an increase is possible but have also established additional criteria by which the short-circuit duty of a paper insulated cable installation should be defined.

Conductor Temperature. Longitudinal expansion of the conductors as they increase in temperature may result in a force large enough to buckle the conductors in the joints and terminations (Fig. 1). The magnitude of the force depends on the stiffness of the conductors between the joints and this latter quantity is a combination of the stiffness of the conductors within the cable envelope and the rigidity of the cable environment. Where cables are laid direct in firm soil, the environment is so rigid that the only stiffness which need be considered is that of the conductors within the cable envelope.

Measurements of strengths of multicore cable and joints, together with full-scale tests, have shown that damage to straight-through joints in 11 kV belted cable installations laid direct may be avoided if the temperature rise of the conductors does not exceed 120°C above the temperature at which there is no longitudinal force in the conductors. A cable laid direct, subject to repeated load cycles, is likely to be free from longitudinal force at a temperature midway between the maximum and minimum operating temperatures.

For the operating temperatures used at present, the nominal maximum conductor short-circuit temperature, which must be respected if damage to joints is to be avoided, is thus 160°C for 11 kV cables. Corresponding data for 1,100 V cables lead to a peak conductor temperature of 140°C, because the lower voltage cables are stronger and, in present practice, the joints are slightly

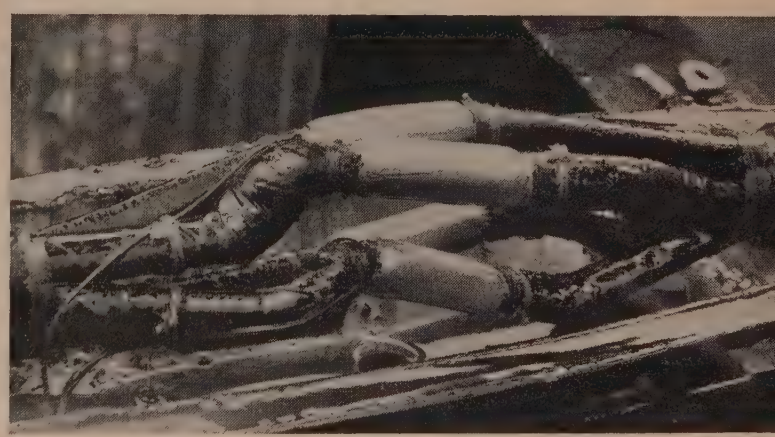


Fig. 1.—Joint damaged by conductor longitudinal expansion

weaker. If strict attention is paid to the construction of joints, a temperature limit of 160°C applied to lower voltage cables should give satisfactory results.

Charring of Paper Insulation. Charring of the paper becomes significant only when the conductor temperature exceeds 200°C. It depends on the nature of the paper and rate of cooling of the conductor. Peak conductor temperatures which just avoid perceptible discoloration vary from 250°C for larger conductors to 300°C for smaller ones. These temperatures are in excess of the limits necessary to avoid mechanical damage to the joints of multicore cables and are applicable only in special cases.

Voids in the Dielectric. Discharge measurements on 11 kV cables and joints subjected to short circuits indicate that there is no permanent deleterious change in the number or size of the voids in the insulation if a temperature limit of 160°C is respected.

Sheath Temperature. In the event of an earth fault, a

cable sheath may be called upon to carry short-circuit current. Lead and lead alloy sheaths suffer damage in the form of longitudinal and circumferential cracks at temperatures above 250°C. Increase in grain size can be avoided if the sheath temperature does not exceed 205°C.

There is always a significant heat loss from a sheath during a short-circuit, and the actual peak temperature is lower than that calculated on a basis of total energy absorption by a margin which is always more than 10 per cent and increases with sheath diameter. If the temperature limit is fixed at 250°C and the current calculated on the basis of total energy absorption, then the heat losses will provide the necessary margin to ensure that no grain growth occurs.

Steel Armour. The sheath may be relieved of fault current by steel wire armour to an extent which is usually important and may with sufficient accuracy be calculated from the d.c. resistance of sheath and armour at 20°C. Armour bonds and clamps must be well made and carefully fitted if this relief to the lead sheath is to be achieved and maintained. No relief is given by steel tape armour.

Bursting by Electromagnetic Forces. If the current is determined by a maximum conductor temperature only, very high currents of short duration are permissible and the possibility arises of electromagnetic forces bursting the envelope of multicore cables. Assuming that the safe current is 70 per cent of the bursting current, then the permissible current is given by $I = 2{\cdot}04\sqrt{[s(f_p t_p + f_s t_s)]}$ kA r.m.s. where s=distance between conductor axes and f_p, t_p and f_s, t_s are the tensile strength and thickness of the belt papers and sheath (lb and inch units). The current calculated, using measured values for the strengths of the materials, agrees with experimental values.

Application of Ratings. A cable can thus be said to have three short-circuit limits determined by conductor temperature, by bursting forces on the cable envelope, and by sheath temperature. Bursting limits the conductor current to a maximum value irrespective of fault duration. Either conductor or sheath temperature may be decisive depending on the relative values of the three-phase and earth fault currents determined by the particular installation.

Mains Cables

For something like 22 years, distribution engineers have calculated the safe fault carrying capacity of their paper-insulated lead-covered mains cables on the assumption that the conductor temperature should not exceed 120°C. This figure was attributed in 1938 to S. W. Melsom[1] of the Cable Makers' Association in the report of the discussion on the I.E.E. paper entitled " Safeguards against Interruptions of Supply." Since that time distribution engineers have considered that this figure of 120°C is too low. They have agreed that oil-impregnated paper does not char at anything like such a low temperature, and soldered joints do not weaken until the melting point of tin is reached, and that under short-circuit conditions the temperature of the conductor of a cable might be permitted to rise to say 250°C. The problem was therefore referred to the E.R.A. and now after some years of research work Gosland and Parr[2] have produced some reliable and very valuable information based on actual experiments.

These experiments, which are given above, have shown that if the conductor of a cable is raised above 160°C, it is likely that joints in the run of the cable will be damaged by buckling. They have also shown that if the fault current returns through the lead sheath of a cable the temperature of the sheath itself must not rise above 250°C or it is likely to be damaged. In addition, certain heavy fault currents, which can be calculated, can cause bursting of the paper belt or even the lead sheath of a cable and these values must not be exceeded.

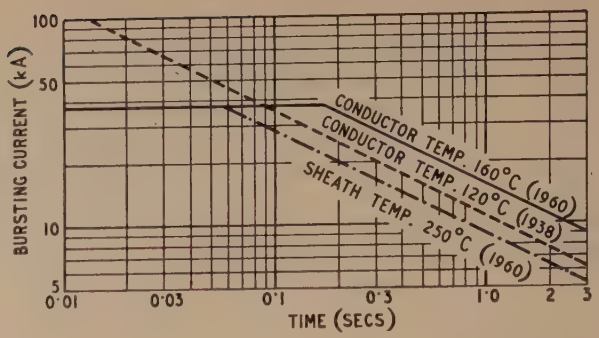


Fig. 2.—Comparison of 1938 and 1960 recommendations for safe current carrying capacity of three-core 0·2 sq in p.i.l.c. 11 kV cable under short-circuit conditions

High Voltage Cables. Fig. 2 illustrates graphically the effect of these results on the short-circuit currents which can be safely carried by h.v. mains cables up to 11 kV. In general, the new figures are higher than the 1938 ones, but engineers must be careful to see that the cable bursting currents are not exceeded for however short a period. They must also see that fault currents passing along lead sheaths of cables are kept as low as possible. This can be done by ensuring that any wire armouring over the sheath is in good condition and properly bonded at joints so that it carries a fair share of the return current.

In assessing the safe fault currents which cables can carry, it is necessary to know the possible duration of the short-circuit before it is interrupted. The shortest time recommended in the paper for h.v. cables is 0·20 sec and the longest is 3 sec; this is the maximum time allowed by the C.E.G.B. for Area Board back-up protection to operate.

In modern h.v. distribution networks, which have their neutral points earthed through resistances (or reactors) at substation positions, the danger arising from short-circuits to earth is negligible. The fault currents to earth are limited by the earthing resistance to such reasonable figures that the cable conductor is never heated to an unsafe level in periods of up to 3 sec. Phase-to-phase faults, however, are not limited by neutral earthing resistances and these are the faults which do the damage. This may be particularly true if the short-circuit becomes a double earth fault and heavy currents pass back to the substation through the lead sheath and armour of the cable. Screened cables, with joints carrying the screen through, would assist in preventing earth faults becoming short-circuits between phases and this would reduce the liability to damage from such severe breakdowns.

Comprehensive figures are given in the paper by G. S. Buckingham for all sizes and types of paper-insulated mains cables used in distribution networks up to 11 kV. These should be of assistance to distribution engineers seeking accurate information about possible damage to their cables.

Medium Voltage Cables. The neutral points of medium voltage networks cannot, of course, be earthed through a current limiting resistance. Earth faults on such cables

will therefore be as severe as phase-to-phase short-circuits. If such cables were not protected by carefully selected high speed h.r.c. fuses there is no doubt much more damage would be done to them. For example, with a fault level of 25 MVA at 433 V a four-core 0·30 sq in p.l.y.s.t.s. cable would only be safe for 0·10 sec and a four-core 0·06 sq in cable could not be protected at all except by a h.r.c. fuse which cut off the prospective fault current before it developed. In properly protected networks, the greatest possibility of danger arises from the use of small service cables teed to large mains; they could be overheated by currents which would not be great enough to blow the substation main fuse. Experience has shown that these small cables are very robust and damage to them is very rare.

The practices adopted by Area Boards are usually repeated on a smaller scale in large industrial factories and workshops. Occasionally, however, it is possible to find such installations controlled by automatic circuit-breakers without h.r.c. fuse back-up protection. If such circuit-breakers fail to operate very quickly, damage to long lengths of medium voltage mains cable is possible.

It is to be hoped that the Electrical Research Association will continue the good work they have been doing on this subject. Their programme should include experimental work on screened 11 kV cables and on cables with aluminium conductors about which there is practically no information at present. Some work will also be essential soon on cables insulated with plastic materials such as p.v.c. and polythene which are coming into popular use.

DISCUSSION

Mr. L. H. Welch (London Electricity Board) said that the fault duration time of 3 sec adopted by the authors imposed an onerous duty on any ordinary distribution system and, on the 11 kV side, would probably occur only with such things as busbar faults not cleared by quick-acting protective gear. Should systems be designed to cater for this very rare occurrence? Should they seek to provide a perfect system which never broke down, or one which cost a tenth of the price and gave 99 per cent service?

Mr. P. M. Hollingsworth (B.I.C.C.) said that very little had been known about the behaviour of cables under short-circuit conditions prior to the work of the E.R.A. The most significant fact which this work and the result in uprating the short-circuit temperature to 160°C had disclosed was the effect of the lead sheath in limiting short-circuit ratings for unarmoured cables or cables where the wire armour was suspect. If lead sheath thicknesses were further reduced (as they might be in the next standard, to line up with Continental standards) the situation would become even worse. The aluminium sheath was an obvious alternative. The corrugated aluminium sheath would have a rating, depending on size, 1¾ to 2½ times that of an equivalent lead sheath. With l.v. cables there might be the possibility of using a copper sheath, which would probably be much thinner but have the same rating as an aluminium sheath.

Mr. R. S. Orchard (Merz & McLellan) commented on the wide range of short-circuit times, from 0·2 to 3 sec, given by Mr. Buckingham and suggested that supply undertakings should try to fix for themselves some short-circuit time appropriate to their conditions. For a transmission system with circuit-breaker operation of a discriminating type, he suggested a figure of 1 sec, though with delay protection and auto-reclosing it might be necessary to think again. For power-station circuits with so-called instantaneous protection, the figure might be 0·5 sec, and for h.r.c. fuse protected circuits 0·2 sec.

Mr. W. H. Lythgoe (A.E.I.) regarded 3 sec as reasonable in the conditions of modern distribution systems.

Mr. C. C. Barnes (C.E.G.B.) suggested that if the recommendations in Mr. Buckingham's paper were strictly followed, very much larger conductor sizes than those hitherto used would be necessary. Reference had been made to loose sheaths and deformation of the lead sheath. Tight lead sheaths could be applied by experienced manufacturers. Greater use was being made of aluminium sheaths and this should help.

Mr. D. E. Bird (Ewbank & Partners) said the authors had shown that the use of plain lead-covered cable should generally be avoided; the cost of wire armour was less than that of the additional copper otherwise required. Single-core cables, however, could not be armoured and their short-circuit capacity appeared to be very low.

Mr. D. T. Hollingsworth (B.I.C.C.) pointed out that the tests described had been carried out on ordinary cables the designers of which had probably taken little account of the short-circuit capacity required in a modern transmission system. If there was need to increase the short-circuit rating, it should be possible to add to the mechanical strength of a cable, for instance by increasing the hardness of the copper conductor or of the lead sheath.

Mr. A. G. Thomas (Alcan Industries) said the limitation with normal cables was the effect of the expansion of the cable in causing damage to joints. Aluminium had a greater coefficient of expansion than copper and it might be thought that this was a disadvantage but, in the joint, the expansion was partially restrained and the force required to do this was lower with aluminium because its modulus was lower than that of copper. An aluminium sheath had much greater circumferential strength than a lead sheath, and a 0·19 sq in cable with aluminium sheath had withstood 46 kA for 0·42 sec. An aluminium sheath would carry 3½ times the current of a lead sheath, while the corrugated aluminium sheath would carry 1·75 times the current.

Mr. J. Soloman (C.E.G.B.) pointed out that Mr. Buckingham himself agreed that several installations for 3·3 kV and above were running quite satisfactorily with cross-sectional areas very much below the 0·2 sq in recommended.

Mr. H. Lloyd-Williams mentioned that in about 1949-50, owing to shortage of steel for armouring, they had used aluminium armour and it had become clear that with its lower resistance and lack of inductance the new aluminium armour was stealing the return current.

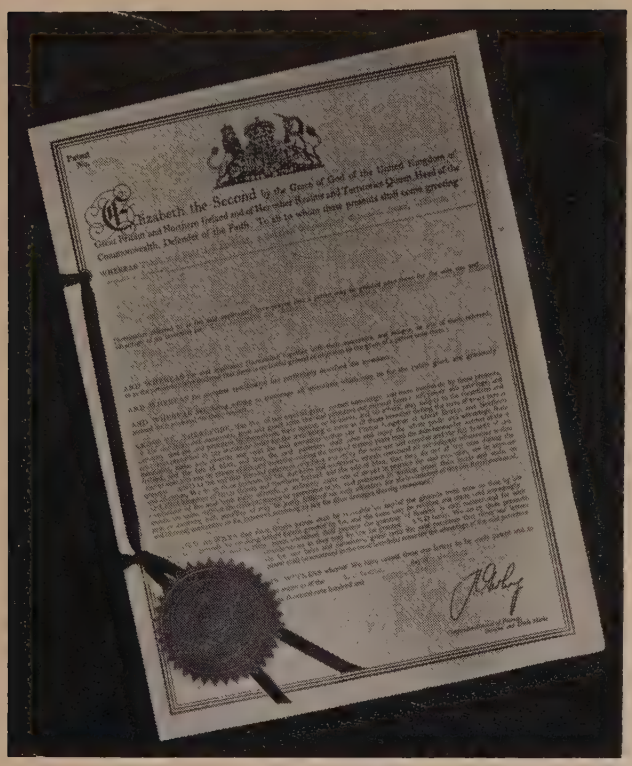
Mr. N. Barnes said that he had prevented corrosion of the wire armouring by using p.v.c. sheathing, but the difficulty of making an effective connection with the wire armouring remained.

Mr. C. T. W. Sutton, Mr. P. d'E. Stowell and Mr. A. Morello (written communication) also made brief contributions to the discussion, to which Mr. Parr and Mr. Buckingham replied. Mr. Buckingham remarked that it was the high quality of the cable used which had prevented more serious trouble being experienced in the past. They were watching with great interest the developments in the use of aluminium, in which his Board had been pioneers. Most of the difficulties related to the jointing; the soldering processes were not very satisfactory. They would be very willing to use aluminium more and more if the practical difficulties could be overcome.

REFERENCES

[1] Melsom, S. W.: Discussion on "Safeguards against Interruptions of Supply," *Journal I.E.E.*: 1938, 82, p. 479.

[2] "A Basis for Short Circuit Ratings for Paper Insulated Lead Covered Cables up to 11 kV" (E.R.A. Report Ref. F/T 195: 1960).



A typical Letters Patent on the cover of a folder containing the specification

Some guidance for the benefit of those who are not very well acquainted with patents procedure is given in this article which reviews very briefly some of the principal features of British practice relating to the filing of patent applications and specifications and the subsequent procedure. Finally the meanings of the relevant dates that are frequently referred to in correspondence dealing with patent matters are explained

By S. AUSTEN STIGANT
M.I.E.E., Fellow A.I.E.E.

British Patents Procedure

A PATENT application may be filed in the name of the inventor alone, in the name of the inventor's assignee, or in the name of the inventor joined with that of a non-inventor, such as a company. The full names and addresses of all the applicants must be stated, and in the second case the inventor must be stated and must assent to the application; his name will be printed on the published specification. The application should be filed before any details of the invention to be patented have been published by the applicant or any other person. Failure to do so may result in the invalidity of the patent, if granted. However, a paper given to a learned society by the inventor or a display by the applicant at an exhibition certified by the Board of Trade do not detrimentally affect the patent, even if occurring before the date of application, provided that the application is filed within the ensuing six months. For these reasons, it is important to file the application at the earliest opportunity.

When it is desired to protect an invention by Letters Patent in Great Britain it is common to file at the Patent Office, with an application for a patent, a so-called provisional specification. The invention is described in this specification as fully as possible, to permit elaboration of the basic ideas when the complete specification is subsequently filed. A provisional specification does not contain claims and need not be accompanied by drawings, although the latter may be included and are in some circumstances desirable. It is not printed until the complete specification is printed and then both provisional and complete specifications are contained in the same publication. An application may be filed, however, with a complete specification in the first instance, instead of a provisional specification, if circumstances make it advisable.

It is to be noted that formally the priority date of any claim is that of the complete specification *unless it can be shown that that claim reads on to the provisional specification.* The present function of a provisional specification, therefore, is to establish a priority date for what has been invented at the date of filing that specification. Any additional matter included in the complete specification carries a priority date corresponding to that of filing the complete specification.

Twelve months from the date of first filing a provisional specification is normally allowed by law to enable an applicant to develop his invention to a practical or commercial stage where, in a complete specification, he can describe it more fully. This period is thus the "life" of a first provisional specification and during this time the specification is kept wholly secret. If a complete specification is not filed before the end of the twelve months' period—or any permitted extension—the application lapses and the priority date is lost. A provisional specification is accepted by the Patent Office for filing and recording as it stands and without examination or any search being made in regard to priority or patentable substance.

Additional provisional specifications covering improved or modified features not visualised in the first provisional, may be filed during the twelve months allowed for filing

the complete specification and they may be combined (or cognated) with the original filing when preparing the complete specification. Priority dates for the claims in such a cognated complete specification are those of filing the respective provisional specifications that first described the improvement or modification.

Complete Specification

Within twelve months (with a possible extension to fifteen months) of filing a provisional specification or the first provisional specification in the case of cognate applications, an applicant, if he wishes to continue with his application, must file a corresponding complete specification at the Patent Office and this document provides a more detailed account of the invention. It also contains whatever drawings are considered necessary and a list of the claims that are made for the invention. These claims set out what the applicant considers to be the novel features of the invention and are probably the most important part of the document.

At this stage the Patent Office examiner very thoroughly examines the specification to ensure that its subject matter *is* patentable and that its claims have not been anticipated by prior specifications. If the examiner finds any prior specification or other document which he believes anticipates any claim, he notifies the applicant who may then argue that there is no anticipation or may amend his claims to avoid anticipation. When the examiner is satisfied that anticipation does not exist, or no longer exists, the application is accepted.

There is no fixed lapse of time between the date of filing the complete specification and the acceptance date, but this must not be longer than three years six months. The time period depends upon the amount of work the Patent Office has in hand at the time. Up to the acceptance stage the specification has remained secret. Upon acceptance the Patent Office then prints and publishes the patent specification with its allotted six-figure serial number and it is left open to public inspection for three months.

Following publication of the complete specification, opposition may be filed at the Patent Office by any interested party during the three months subsequent to publication. The Patent Office then notifies the applicant of the substance of the objection which must either be refuted by him to the satisfaction of the Patent Office or else accepted. The latter course may entail alterations to the specification (usually to the claims) or even abandoning the application. After written arguments by the applicant and opponent, the opposition is argued verbally before the Comptroller or one of his officers, who finally decides the fate of the application.

An invention may be referred to as " Patented " only after Letters Patent have been issued. Prior thereto an applicant may use words such as " Patent applied for."

Letters Patent are *granted* to the applicant if no opposition to the published specification is filed during the public inspection period, and the formal patent document is then issued to the applicant upon payment of the sealing fee. If opposition is filed, final granting and issue of Letters Patent is delayed until the Patent Office is satisfied with the outcome of the objection. It is important to appreciate that a patent *application* has no legal value until it becomes a *Patent*, that is until Letters Patent have finally been issued. Damages may, however, be sought for infringement taking place after publication and before granting.

An applicant may be dissatisfied with the examiner's final ruling on an issue, either at the stage of examination for acceptance or arising from opposition proceedings, or both. In the first case the applicant may seek a hearing before a hearing officer in the Patent Office and if his decision is still not accepted by the applicant he may take the matter to the Patents Appeal Tribunal. In the second case an appeal from the Patent Office decision on the opposition may also be taken to the Patents Appeal Tribunal.

Even an issued patent may be revoked later if subsequently another party can prove that, for example, the claims of the published complete specification have, in fact, been anticipated, even although the examiner himself did not discover the fact. Applications for revocation by the Patent Office must be filed within one year of the date of sealing of the Letters Patent; for revocation by the High Court applications may be filed at any time.

Patent Life

In Great Britain a patent remains in force for four years from the date of filing the complete specification, when the sealing fee has been paid. It may then be renewed annually to be kept in force for a total period up to sixteen years from the date of the patent, that is, from the date of filing the complete specification. Further extension (up to a maximum of ten years) is possible only in certain very special cases.

Convention priority relates to foreign patent applications (based on a country-of-origin patent application) filed in any country that is a party to the International Convention for the Protection of Industrial Property, under the terms of which protection abroad with full priority can be obtained only if a complete specification is filed in the foreign country within twelve months from the date of the *first* application in the country of origin. The Convention priority date for Great Britain is thus the date of the first filing of an application with either a provisional or complete specification in Great Britain and applications must be filed in the Patent Office of the foreign country concerned within twelve months of that date. No extension of time beyond the allotted twelve months is permitted in respect of such foreign applications if the priority date is to be maintained. Foreign applications filed after the twelve months referred to lose the Convention priority date, and may result in invalid patents if any publication of the invention has occurred between the date of filing the British application and the date of filing the overseas applications.

Filing Abroad

When an applicant wishes to obtain a foreign patent based on a country-of-origin patent application he must file a complete specification and not a provisional. This must be done within twelve months of the Convention date as already stated. In the majority of cases, with foreign applications the date of filing the first provisional specification will be the priority date. However, in some countries (such as the U.S.A.) the specification from which priority is claimed may be carefully studied by the examiner who may refuse the priority date on the grounds

that by the standards of the country concerned the invention was not properly disclosed in the provisional specification. Again, many countries employ the notion of partial priorities in which any claim reading on to the provisional specification is accorded the date of filing of that specification and any claim not reading on to that specification is accorded the date of filing of the foreign application. Regardless of these considerations, however, the foreign applications should be filed within a year of the filing of the first provisional specification, unless the foreign applications are to claim only matter first described in the complete specification or if the applicant is satisfied to have, for the priority date of all the claims of his foreign application, the date of filing of that foreign application.

In some foreign countries the respective Patent Offices operate in a manner similar to that of the British Patent Office; but in other countries (of which France is an example) the specification is accepted *as filed* and Letters Patent are granted shortly thereafter without any search for prior publication being made by the Patent Office concerned. It is very important, therefore, to bear this in mind when negotiating manufacturing and selling licences for an article patented abroad, particularly if there is no corresponding British patent. It is an offence for a person or company resident in the United Kingdom to file a foreign patent application unless a corresponding British application has been filed at least six weeks earlier.

A patent agent makes a search to establish the existence of prior inventions only when so requested by the applicant; he is not expected to do this simply as a matter of course when an application is filed. As already indicated the Patent Office examiner makes a search automatically as part of his duties when he comes to examine the complete specification.

Relevant Dates

Application Filing Date. That on which the application, whether accompanied by a provisional or complete specification, is first filed at the Patent Office. It is also fundamentally the Convention priority date.

Complete Specification Filing Date. That on which a complete specification is filed at the Patent Office. It is also the date of the patent, if later granted.

Acceptance Date. That on which the Patent Office accepts the complete specification either as originally filed or as subsequently amended.

Publication Date. That on which the Patent Office publishes the patent specification.

Opposition Period. The period of three months following publication during which the printed specification remains open to public inspection.

Granting Date. That on which the Patent Office finally grants Letters Patent.

Sealing Date. That on which the Letters Patent are actually sealed following payment of the sealing fee. It is the same as the granting date.

Date of Issue. That on which Letters Patent are actually issued by the Patent Office. It is the same as the sealing date.

Patent Date. That of the official Letters Patent. It is the same as the complete specification filing date.

Date of Working. That up to which a patented invention must be worked on a commercial scale to maintain control of the patent rights. It is up to and within three years after the sealing date. If not so "worked" an interested party might be able to obtain a compulsory licence.

Priority Date of a Claim. The date of first filing the specification in which the subject matter of the claim was first described. It may be the date of the complete specification or the date of the provisional specification when the subject matter of the claim appears in that provisional specification.

Convention Date. The Convention priority date for foreign applications is the date of the first filing of the specification (provisional or complete) in Great Britain.

Patent Life. Four years from the date of filing the complete specification, after which it may be renewed annually for a further twelve years, giving a total of sixteen.

It is customary for the true inventor, when in the employ of another person or of a company, to be required to assign to his employer all his rights in a patent to which his name is attached, so long as the invention has resulted from the office held with the employer. An exception to this requirement is in the case where the terms of employment specifically provide that the inventor shall retain his rights in any patent with which his name is associated as the true inventor. Where an application is made in the name of the inventor's assignee such assignment should be executed before an application is filed in the name of the assignee.

The following literature is recommended for a more comprehensive study of the subject:—

A Compendium of Patents and Designs Law and Practice. Reginald Haddan, 1931.
The International Convention for the Protection of Industrial Property, 1938.
Patents Acts, 1949 and 1957.
The Patents Rules, 1949 and 1955.
The Patents Appeal Tribunal Rules, 1950.
Patents and Registered Designs. T. A. Blanco White, 1950.
Terrell and Shelley on the Law of Patents. K. E. Shelley, K.C., 1951.
Patents for Engineers. L. H. A. Carr and J. C. Wood, 1959.

More Power for DIDO

THE power of Harwell's research reactor DIDO has been increased by loading it with a new core. This reactor is used for the testing of materials and components for future reactor systems; it is also used as a basic research tool and for the production of radioisotopes. The improvements to the core are designed to increase the number of experiments that can be loaded into the reactor at one time, since some of these absorb a considerable proportion of the available reactivity.

The new core consists of 25 hollow fuel elements with an increased U235 content. The old plate-type fuel elements contained 115 gm of U235 per element whereas the new type contains 150 gm of U235 per element. Experimental rigs of up to 2in diameter can now be accommodated within the fuel elements in regions of extremely high fast-neutron flux. The modifications have increased the total number of available high flux experimental positions from 27 to 52; the additional fast-neutron positions within the fuel elements will be of great value for high dose irradiation damage studies of graphite, fuel canning materials and other materials for power producing reactors.

Originally DIDO operated at a power of 10 MW and had a maximum thermal neutron flux of about 2×10^{14} neutrons/cm^2/sec. The modifications have increased the reactor power level to 13 MW but the thermal neutron flux has remained substantially unchanged. The reason for this is that the power of a thermal reactor depends upon the product of the mass of U235 in the core and the magnitude of the thermal neutron flux.

Automation or Frustration ?

So reliant is modern man upon electrical equipment and appliances that soundness of construction and continuity of operation are imperative. The sequence of untoward events imagined by the author is, of course, fantastic but it points a moral

COULD IT HAPPEN HERE ?

By S. L. M. BARLOW, M.I.E.E., M.Amer.I.E.E.

I WONDER if we realise just how dependent the modern generation is upon electrical science as applied to the everyday things in life and the frustration with which we could be faced if reliability in design and manufacture was not maintained at its present high level. With the ever-increasing demand for new electrically operated mechanical aids, it seems to me that we have to guard against a lowering of standards which so often follows such a trend. Take for example, the car clock, at one time a reliable instrument but now a useless and doubtful ornament.

Most of us would admit that the Americans still have the edge on us in the field of mechanisation, but it seems to me that they have also fallen into the trap of producing a small but increasing number of badly constructed gadgets, and marketing still more, which are readily available to the consumer under the misnomer of mechanical or household aids. I have recently returned from America and it was, I think, two chance remarks which set my mind tracking on the possible disasters which could befall one during a single day if electrical failures persisted during such a period.

The first remark was made to me by a business man who led me into his semi-darkened office on the 20th storey of a New York skyscraper and, as a prelude to his business talk, apologised for the obstructed daylight by explaining that he was sorry but something had gone wrong with the electrically operated drapes and he had not yet been able to get them fixed. It occurred to me that there was no doubt he had got them fixed, but I let that pass.

The second remark was made by a housewife and mother of four charming daughters, who said quite seriously that she thought that included in the domestic science classes attended by her offspring should be a reasonable period devoted to electrical maintenance. For one brief moment I found myself wondering if she had not been awakened by the current and persistent cry in America for the training of more and more scientists and technicians, but, alas, this was not so.

Let us consider, therefore, some of the hazards which could befall an imaginary character in New York during the course of just one day in this age of " high standards of living." I choose New York, not because it is any better or any worse than other cities in the world but because it is much easier to accept the premise that perhaps things may more readily go wrong with equipment other than that manufactured in your own country—a comforting thought, but seldom true. Anyway, here is his day:

It was probably the fact that the alarm clock failed to go off at 6.30 a.m., plus a reluctance on the part of his electric razor to emit its normal high pitched buzz, that made our character late and unkempt in sitting down to his breakfast. He usually had plenty of time to listen to the news or see some TV on one of the seven channels available to him while he ate his breakfast, for it seemed to him a pity to miss all this free entertainment. This morning he found difficulty in concentrating on TV while trying to discover why the pop-up toaster not only refused to pop up, but seemed to retain his toast in an iron grip. His bathwater had been cold anyway and he knew that his electric hair oil dispenser was not very reliable, but he just could not understand why the mail had not been delivered. Perhaps it was that it had been delivered but that his door chimes were not working. He went to the door of his flat to look for the janitor who normally transported the mail from the ground floor and delivered it at his floor. There was no one about so he tried to get him on the microphone call system installed between each flat and the front lobby. It was useless; maybe the janitor was out finding someone who could repair the elevator which usually kept him awake most of the night, but now seemed ominously silent. He returned to his flat, the coffee had not percolated and the waffle iron had not browned his waffles. This was really most unfortunate and a bad start to the day. He would walk down those twenty-two floors and go to the office late, exhausted, unshaven and ill-informed.

At the Office

As the telephone had been suffering from some slight defect it was not until he had arrived at the office that he was advised that it was really rather fortunate that a subway breakdown had resulted in only a small section of his staff reporting for work, because one of the air conditioning units had developed a serious fault and so it would not be possible to obtain the required number of air changes in his office for a full complement of employees. This was, of course, a modern building which had none of those old fashioned windows that actually open, and as he sat down to his desk he wondered if perhaps he was worrying unnecessarily about things, and that it was more the continual flicker from the fluorescent lamps which failed to strike behind his illuminated ceiling which was irritating him, rather than the usual flashing sign on the building opposite which, by some strange coincidence, was at this moment out of commission.

Anyway he could at least get some dictating done, and it was only when his secretary failed to appear on the screen of his new and recently installed visual call system that he wondered if the merits of seeing her on the screen

instead of in the flesh had justified the removal of a simple buzzer system and the installation of this rather frightening piece of apparatus. Of course, it looked impressive, and the salesman had assured him that if he had not ordered it at that moment he might not have been able to get one at all. He started to fiddle with his dictating machine. It was all right yesterday. In fact he remembered the maintenance man had spent nearly half the morning getting it to work, but now it did not even emit a crackle. This was impossible! He would just have to take the rest of the day off. He went into his secretary's office; she seemed to be having trouble with the copying machine. Oh well, she would probably not miss him for a while.

This was, of course, maintenance day for the fast lift, so, in spite of the fact that it always seemed to upset his stomach, he took the one which stopped at every floor. It was a nuisance that the selenium cell door control system was not working properly and that as a result he had rather badly bruised his arm when it became trapped in the door on the way in, but that did not seem to annoy him so much as the red hot blast of air impinging on his bald head, which was presumably due to the thermostat on the lift cage heater having given up the ghost.

He walked out into the streets of New York and filled his lungs with a mixture of burnt fuel and fresh air. At least he could just see the sun for a few brief moments as it filtered down the shaft-like gap between the tall buildings, before he made his way down the escalator stairs to the subway. Why was it, he wondered, that they always made the handrail travel at a different speed from that of the stairs. Surely in this mechanical age someone must have thought of some method of synchronising them and curing this annoying feature of these infernal machines.

He got out at his station, passed through a haze of inarticulate loudspeaker announcements, to his favourite quick service drugstore. He listened vaguely to the nylon clad female assistant pass his order for a triple-decker hamburger by microphone to the kitchen, while someone at a nearby table inserted a nickel in the automatic record selection machine which, after a clicking of relays, proceeded to churn out a much worn and unrecognisable record.

Home Again!

All at once he realised that he was a tired dispirited bachelor and that he must pull himself together. He must hurry back to his flat and try to get that infernal sink disposal machine operating again, as it was beginning to exude an unpleasant smell. To deal with his washing up was bad enough and he only hoped that at least his washing-up machine had a few hours of useful working life, especially as it seemed only last week that he had spent a small fortune on repairing his refrigerator and now his deep freeze seemed to be operating in a temperature zone outside its dial range. Maybe he had made a mistake in hitting it with the bread-knife yesterday!

As he let himself into his flat door, tired and dejected after having walked up the floors, for the lift was still inoperative, he realised at once that it was not the smell from the sink disposal unit that met him but the smoke which emanated from the oven door of his cooker. Surely he had set the controls accurately when he inserted the ready-made chicken pie this morning, but, of course, he had never really properly understood that battery of dials and red lights. He turned off the cooker, the smell of burnt chicken permeated the whole flat, and as he poured himself a long drink he recalled that long since had his electric drink dispenser ceased to operate, and that anyway it was almost as quick to mix it oneself.

He turned on the stereophonic radiogram, picking out a peaceful record which, together with his drink might soothe his shattered nerves, but, alas, it was not to be. The automatic pick-up arm refused to move.

A feeling of claustrophobia came over him. He must get air and take a walk in Central Park. He had rather foolishly left his car by the kerbside overnight in this less crowded residential part of Manhattan, but even so it was a tow-away area, so he would kill two birds with one stone—move his car and walk in the park. Yes, it was still there. He got in and tried to start the engine, but the battery was flat. He knew that sometimes the switch for the seat moving motors got stuck in, but he had never left the air conditioning unit on before. Why had not he listened to the guy who told him to get it interlocked—whatever that might mean. Even the window winding motors would not operate, so he knew that there was no power to start the engine and these modern cars, of course, had no starting handles.

In disgust he left the car, returned to his flat and fell exhausted on the bed. He felt that this had not been his day, but at last he dropped off into a fitful sleep, thinking that perhaps he had been wise not to get involved with his washing, drying and ironing equipment, his workshop hobbies or even his brand-new electrically operated golf trolley. In the morning he must make some inquiries. Perhaps they were running classes where he could learn to do without these things!

Aerodrome Lighting

WITH the approval of the Ministry of Aviation, the British Standard " Guide to Civil Land Aerodrome Lighting " first published in 1932 has been revised to take account of international agreements and developments in the aviation field. The revised standard (B.S. 1332 : 1960) describes the various types of aerodrome lights and their use at civil land aerodromes to meet the operating requirements of fixed wing aircraft. Since no international standards yet exist for lighting for helicopter stations, recommendations for this have not been included but it is hoped to add them at a later date. The standard is in twelve parts, covering definitions, general requirements, beacons, approach lighting, angle of approach indicator systems, runway lighting, circling guidance lighting, taxiway lighting, taxying guidance, obstruction lighting, luminous landing direction indicators and lighting at grass aerodromes.

Among the types of lights described are forms which have recently been included in I.C.A.O. Annex 14 but are still in various stages of development and operational evaluation: in particular, circling guidance lights and runway surface lights. Notable among these is the two-colour angle of approach indicator system developed by the Royal Aircraft Establishment, Farnborough, which is now being installed at a number of civil airports in the United Kingdom and, following flight trials in America, has been adopted by the Federal Aviation Agency.

Copies of this standard may be obtained from the British Standards Institution, 2, Park Street, London, W.1, price 12s 6d.

New Books

The High Frequency Applications of Ferrites. By J. Roberts. Pp. 166; figs. Published by English Universities Press, Ltd., 102, Newgate Street, London, E.C.1. Price 16s.

In good ferrimagnetic materials there is the attractive combination of strong magnetic properties and very poor electrical conductivity, and by careful preparation it is possible to achieve very low losses even in the presence of magnetic fields alternating at microwave frequencies. It is not surprising, therefore, that ferrites are now most extensively used in a great variety of high frequency applications, and this volume gives an account of some of these uses. There are five main chapters: physical properties of ferrites; inductor and transformer cores; microwave devices; ferrites with rectangular hysteresis loops; and barium ferrite.

In a small volume such as this, it is inevitable that there must be careful selection and abbreviation of the topics discussed, and it is probable that a reader without previous knowledge of ferrites and ferrimagnetism will find the first chapter uncompromisingly brief. However, in the following chapters the author has succeeded in his declared aim " to provide information for the engineer and physicist involved in the design and use of high frequency equipment." Information concerning properties and performance is usually of a general nature and few data are given of the parameters of particular ferrites.

This book certainly provides a useful introduction to the theory and application of ferrimagnetic materials at high frequencies. It is to be regretted, however, that the author does not provide a more extensive bibliography for the benefit of his readers who seek more detailed treatment of the various topics; in all, only 29 references are given. It also seems rather unfortunate that the terms " T site," " O site," and " magneto-gyric ratio " should be used when A site, B site, and magneto-mechanical ratio are firmly embedded in the literature.—K.J.S.

Engineering Management. 2nd Edition. By Struan A. Robertson. Pp. 467; figs. Blackie & Son, Ltd., 17, Stanhope Street, Glasgow, C.4. Price 30s.

This is a new edition of a textbook for H.N.C. and I.Mech.E. students taking the examinations in industrial administration. The author states that it is the basis of a course of lectures given at Battersea Polytechnic (now Battersea College of Technology). If that is literally the case then the students, many of whose experience of responsibility in industry will be small, must be crammed indeed. In the preface, however, the author makes it clear that other methods of teaching, such as class discussions and hypothetical board meetings, are used as well as lectures.

The problem for a teacher of management subjects to part-time students or to undergraduates, is that their lack of much feeling for the atmosphere of industry or of the complex nature of the problems involved may make the subject seem unreal. Nor can it be taught as if it were a subject for which there existed many generally accepted scientific principles. On the other hand, the techniques are mostly of the kind of which any intelligent and well-educated engineer could acquire a reasonable amount of knowledge by reading a single textbook. These include costing, the organisation of management structure, company and industrial law and the formal aspects of personnel management. To some extent, therefore, this book falls between two stools. Although much of it is excellent as an introduction to the spirit in which the subject should be approached, each specialised chapter is too condensed to be intelligible to someone reading about the subject for the first time.

The difficulties of teaching management at too young an age have been emphasised by the Ministry of Education in their circular on The Future Development of Management Education and Business Studies, which raises both the age and the qualifications of entry to a course leading to a Diploma in Management Studies. What is surely most needed for undergraduates and the like, is some introduction to the social sciences, economics, psychology and sociology, on which management practice must be based, and a method of teaching which encourages the inquiring and sceptical mind.—A.A.

The Dynamic Behavior of Thermoelectric Devices. By P. E. Gray. Pp. 136; figs. Published jointly by the Technology Press of the Massachusetts Institute of Technology and John Wiley & Sons, Inc., New York. Chapman & Hall, Ltd., 37, Essex Street, London, W.C.2. Price 28s.

This book, the sixth in a series of Technology Press Research Monographs, investigates the small-signal dynamic behaviour of thermoelectric devices. The comparatively recent development of practical thermoelectric generators and heat pumps has been made possible largely by developments in semiconductor thermo-elements. Research is currently being carried out in both materials and devices and it is with the second category that the study reported in this book is concerned, specifically thermoelectric heat pumps and generators. These devices are described by partial differential equations containing non-linear terms and are subject to boundary conditions that contain product-type non-linearities. The small-signal analysis employed permits the treatment of linear models and a number of transfer functions have been produced which can be used either to compute the response of devices in the frequency domain or to calculate their response in the time domain. The book, which contains seven chapters, nine appendixes and a list of 17 references, is based on work sponsored by the U.S. Air Force.—T.R.W.

BOOKS RECEIVED

Dictionary of Electronics. By Harley Carter. Pp. 377; figs. George Newnes, Ltd., Tower House, Southampton Street, Strand, W.C.2. Price 35s.

A History of Platinum. By Donald McDonald. Pp. 254; figs. Johnson Matthey & Co., Ltd., Hatton Garden, London, E.C.1. Price 35s.

Induction-Type Integrating Meters. By G. F. Shotter and G. F. Tagg. Pp. 214; figs. Sir Isaac Pitman & Sons, Ltd., Pitman House, Parker Street, Kingsway, London, W.C.2. Price 63s.

INDUSTRIAL NEWS

Commercial Freedom for the Post Office

THE Post Office Bill, presented to Parliament last week, puts into legislative form the proposals set out in the White Paper "The Status of the Post Office," which was summarised in the *Electrical Review* of 8th April, 1960.

The Bill puts the Post Office on the same commercial basis as the other nationalised industries, but it will remain a Crown Department under a Minister. Parliamentary control will be secured because the Minister's salary will continue to be voted annually.

The main foundation of Treasury control of Post Office finances is to be removed by the setting up of the Post Office fund, for which the Postmaster General is to be given complete responsibility. But the Treasury will be left with control over staff conditions, investment and borrowing control, and foreign exchange control.

It is estimated that the initial Post Office borrowing indebtedness to the Treasury will amount to about £800 million and the effect of the Bill will be to authorise additional borrowing up to about £80 million, a limit which may be increased by another £80 million on a House of Commons resolution.

On the assumption that the requirements of the Post Office for fixed and working capital in the next four years amount to nearly £500 million and that about two-thirds can be financed internally, the proposed limit of £80 million "should meet requirements for about two years and that of £160 million for around four."

NUCLEAR POWER STATION SITES

REPORTING on investigations carried out into possible nuclear power station sites in southern England, the Central Electricity Generating Board says it has been found that Earnley, in Sussex, is technically unsuitable for development. On the other hand, Hamstead, Isle of Wight, is an excellent site. The Board believes that, with close attention to design and landscaping, a station could be built there with little real damage to amenity but, conscious of the amenity value of the West Solent, it realises that the psychological impact of the station may be great. It is therefore deferring any decision on seeking consent to use the site and is considering an alternative way of providing more power in southern England at a reasonable cost.

The demands of the southern counties can be met either by building stations on the south coast near to the areas where demand is rapidly increasing or by building stations in parts of the country remote from the area of demand with transmission to the south coast. The C.E.G.B. is reluctant to adopt the second alternative too widely for amenity reasons. Because transport charges on nuclear fuel are negligible, it is possible to generate nuclear power on south coast sites as cheaply as elsewhere, and it is for that reason that the Board has sought sites for nuclear stations on the south coast.

An alternative development to meet the power demands of the southern counties while minimising transmission would be to build a conventional station on Southampton Water, but this has the disadvantage that a coal-fired station would increase materially the cost of power in the Southern Board's area as compared with alternative schemes. More time is necessary for the investigation and consideration of conventional alternatives.

Locomotive Works to Close

The Metropolitan-Vickers – Beyer Peacock electric locomotive building works at Stockton-on-Tees, jointly owned by Associated Electrical Industries, Ltd., and Beyer Peacock, are to close next February owing to lack of work. More than 320 employees will be involved.

Hotpoint Home Centre

A.E.I.-Hotpoint's new Home Centre in London's West End will be open to the public from 3rd January. Occupying 6,000 sq ft on two floors in a new block of shops at the junction of Oxford Street and John Princes Street, the Home Centre will be available as a source of information on all aspects of housecraft. In addition, the full range of Hotpoint domestic appliances will be exhibited. Accommodation is being provided for full-scale demonstrations of appliances and will include a lecture theatre and cinema.

TRANSISTORISED COUNTERS

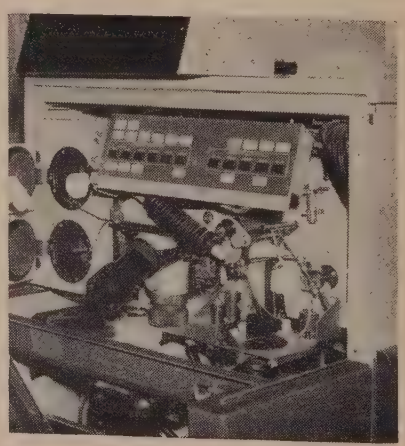
Under a recent agreement with the Computer-Measurements Company of Sylmar, California, Marconi Instruments, Ltd., are to manufacture C.M.C.'s range of transistorised electronic counters and, outside North America and Japan, they will enjoy world selling rights. The agreement is for a 10-year period. It also includes provision for the exchange of engineering information in the field of related transistorised products.

Electronic Reading Equipment

THE first production model of ERA —Electronic Reading Automaton— was demonstrated by the Solartron Electronic Group, Ltd., at Farnborough, Hants, recently. This equipment employs a flying spot signal system to read characters printed on a paper roll at speeds up to 300 characters/sec. The output signals may be used to drive a card or paper tape punch, to write on magnetic tape or may be fed directly into a computer. The machine demonstrated accommodates a 2½in wide paper audit roll from 20in to 48ft in length, representing from three to 2,000 lines of print.

It is designed to read numerals from 0 to 11 inclusive, seven alphabetical characters and the plus sign. There are 212 valves, two cathode ray tubes, 3,496 transistors and 18,139 diodes in the equipment, which has a power consumption of approximately 6 kW.

The scanning console interior of the Solartron electronic reading automaton



Transformers with Aluminium Tanks for Australia

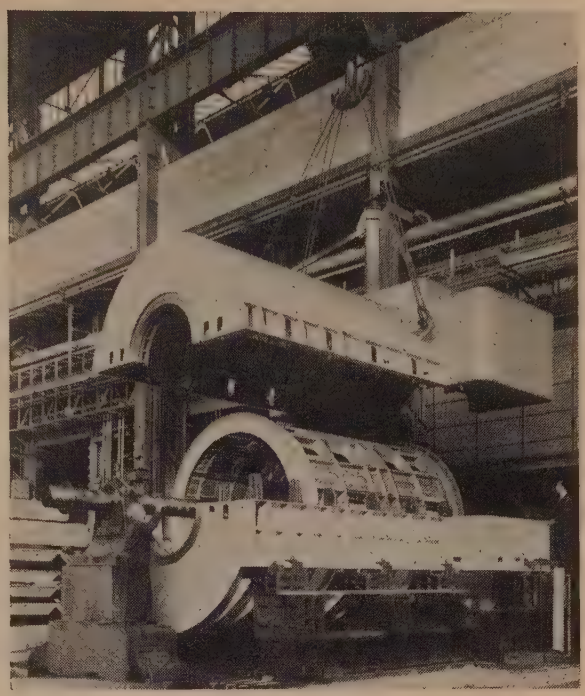
Against strong competition from Continental and Asian countries, Ferranti, Ltd., have obtained a contract from the Electricity Commission of New South Wales, worth over £400,000, for the supply and installation of three 240 MVA, 16·5/348 kV, three-phase generator transformers.

The units, which, it is claimed, will be the largest with aluminium tanks ever built in the United Kingdom, are to be installed at the Vales Point power station, 70 miles north of Sydney. Integral high-speed, on-load, tap-changing gear will also be provided for each unit, the first of which is scheduled for delivery about the end of 1961.

Aluminium tanks will keep the weight down for transport purposes. A complete unit with cooling equipment will weigh 265 tons, of which the largest single section weighing 147 tons will be the core, windings, on-load gear and tank assembly.

This load will be the largest ever handled by Sydney Harbour's floating crane, which has a capacity of 150 tons. A specially constructed road-rail wagon will take the transformers by rail as far as Wyee where the rail bogies will be removed and replaced with pneumatic tyre road wheels for the last three miles of the journey.

200 MW Turbo-Alternator Construction



Lifting the top half of a 200 MW alternator stator shell after machining the bore of the inner stator casing, at the G.E.C. Witton Works. Two of these turbo-alternators are being supplied to the South of Scotland Electricity Board for installation in Kincardine "B" power station. In order to minimise the transmission of vibrations from the inner stator casing to the foundations upon which the machine will be mounted, this casing is fixed to the outer shell by four axially-placed leaf type springs

Malvern £500,000 Scheme Completed

COMPLETION by the Midlands Electricity Board of a scheme for the modernisation and standardisation of the distribution system at Malvern, Worcs., was celebrated on 7th December when the chairman of the Board, Mr. W. S. Lewis, presented an electric fire to the last consumer to be changed over from a 200 V to a 240 V supply.

At a luncheon held afterwards at the Abbey Hotel, Malvern, when Mr. E. C. Watson, manager of the Board's Worcester and Malvern District, presided, Mr. Lewis said that the improvement of the system presented them with one of their biggest problems after nationalisation. It had been hoped that the job would be done in five years but in fact it had taken eight and had absorbed a major proportion of the capital and manpower available in the Worcester and Malvern District. It had cost about £500,000, which was what had been estimated in 1951.

On the Board's development generally, Mr. Lewis said that sales were rising at a fantastic rate; in the first eight months of this financial year they were 14 per cent up on the same period of 1959-60.

HIGH OUTPUT MAINTAINED

WITH only one month to go, it is now certain that the rise in electricity output during 1960 will be one of the highest in recent years. The monthly statement issued by the Ministry of Power shows that in November 11,467 million kWh was generated by the Central Electricity Generating Board and the two Scottish Boards, an increase of 12·1 per cent. This is slightly below the average for the eleven months (13 per cent). Last year the rate of expansion was 6·8 per cent.

At the end of November the total output capacity of generating plant in public supply stations was 29,191 MW, compared with 27,564 MW a year ago. Coal consumption so far this year is up by 10·7 per cent on 1959.

In addition to the above figures, 10,020 million kWh was generated outside the public supply system during the ten months up to the end of October, an increase of 16·7 per cent. This total includes 1,651 million kWh generated at the nuclear power stations of the United Kingdom Atomic Energy Authority, 78 per cent more than in the corresponding period of 1959.

ELECTRICITY GENERATED AND SENT OUT FOR PUBLIC SUPPLY

	Fuel consumed Thousand tons			kWh generated Millions			kWh sent out Millions	Output capacity MW
	Coal	Coke and Breeze	Oil	Steam	Water power	Total		
Central Electricity G.B. ...	4,564	71	510·3	10,517	27	10,553	9,933	26,387
North of Scotland H.E.B. ...	23	—	1·5	42	193	241	239	1,041
South of Scotland E.B. ...	327	3	0·8	624	49	673	636	1,763
Total for November, 1960 ...	4,914	74	512·6	11,183	269	*11,467	10,808	29,191
Corres. total for November, 1959	4,383	101	414·6	9,951	262	10,226	9,631	27,564
Inc. or dec., per cent	+12·1	−27·4	+23·6	+12·4	+2·8	+12·1	+12·2	+5·9
Total to date (11 months) 1960 .	44,904	812	4,758	103,809	2,247	106,190	99,946	
Total for corres. 11 months of 1959	40,579	1,046	3,743	92,056	1,819	93,993	88,407	
Inc. or dec., per cent	+10·7	−22·4	+27·1	+12·8	+23·5	+13·0	+13·1	

* The total figure includes generation by other methods amounting to 15 million kWh.

ASWAN CAPACITY INCREASE

Soviet specialists have estimated that the capacity of the hydro-electric station at Aswan, on the Nile, can be increased by 300 MW to 2,400 MW. It is proposed to install 14 turbines at the station instead of the 12 originally planned.

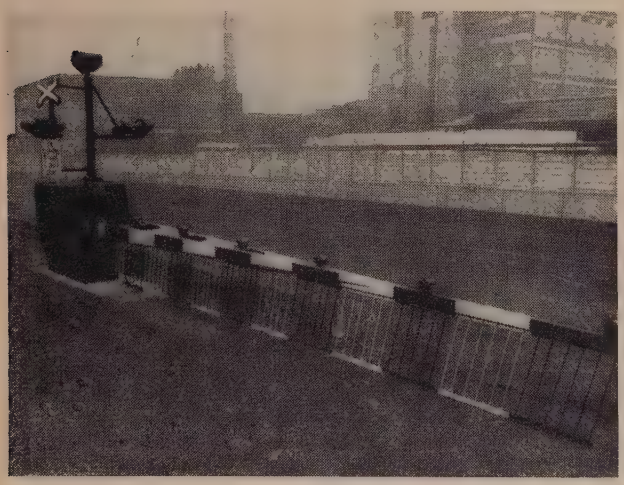
INDUSTRIAL NEWS *[continued*

Level Crossing Barrier

A MANUALLY-CONTROLLED electrically-operated barrier installation has been recently completed at the South Farm Road crossing near Worthing Central station on the Southern Region of the British Railways. The equipment was supplied by Rotax, Ltd., and the installation on each side of the road consists of a pair of lifting barriers—each covering half the road width—a set of front and rear twin red flashing lights, and a set of two-toned gongs. A control console, and a steel triangular structure for mounting the operating battery, charging units, control relays, terminals and fuses have also been supplied. The console is installed in an adjacent signal box and houses the control push-buttons, the normal operating sequence being to illuminate the flashing traffic lights and sound the gong, followed by lowering the barriers facing the traffic stream and then those on the other side of the tracks. When the booms reach a position of 15° from the vertical, indicating lights on the boom are illuminated and on reaching a position of 20° from the horizontal, the gong stops ringing. When the barriers are being raised the lights are extinguished when the booms are 15° from the vertical.

Each boom, which comprises two laminated spruce beams joined by horizontal cross members on which are mounted three 6 W red lamps, is raised and lowered by an actuator. This consists of a compound wound 24 V motor with shunt characteristics driving through a 125 : 1 ratio epicyclic gear box. Between the gear box and the motor is a solenoid operated disc brake. The current taken during boom raising and lowering is 11 A average and for holding in the raised or lowered position 1·2 A. The motor will operate from a supply varying from 16 to 27 V. A rotary switch is moved by the barrier operating shafts and is equipped with 10 contacts, five being used to control the movement of the boom and for switching the fixed and flashing lights, the remainder controlling the gongs and detecting the position of the booms for external signalling.

Rotax lifting barrier for rail/road crossings



There are twin red flashing warning lamps facing to front and rear on each side of the crossing, each rated at 36 W and arranged to give 54/66 flashes per minute, controlled by a transistorised multi-vibrator circuit. The two-tone gongs are mounted above these lights and are audible at a distance of up to 300 yards. The 1·2 A drawn by the bell solenoid is utilised to prevent hammer icing.

A 24 V Nife battery, consisting of 18 nickel cadmium cells and of 200 Ah capacity, is provided. It is float charged at a maximum current of 30 A from two transformer rectifier units, which automatically maintain the voltage across each cell at 1·47 V. The charging units are supplied at 110 V 50 c/s. The battery capacity is sufficient to permit some 250 barrier operations with the mains supply disconnected.

Unusual Sea-Water Evaporator

A PLANT believed to be the first of its kind has just been dispatched to the Sheikdom of Abu Dahbi, on the Trucial Coast, by Richardsons, Westgarth & Co., Ltd. It is a fully self-contained sea-water evaporator which will produce 14,400 gallons of drinking water a day. The unusual feature of this evaporator is that it has been designed to float on its own pontoon. It will be lowered into the sea some miles off the coast and will be towed in to the beach when it will be hauled on to a concrete foundation. The pontoon remains part of the plant and will be used for storage of the fresh water. The fuel pumps, sea-water pumps, brine circulating pumps, etc., are electrically operated by a self-contained generating plant.

Electrically Heated Flats

A 14-storey block of flats at Willington Square, Wallsend, which was officially opened last Friday, is the highest yet completed in the north-east. It is the first of three blocks being built by Geo. Wimpey & Co., Ltd., as part of a redevelopment scheme which will provide homes for 354 families. Electric underfloor heating is being installed in each block.

CHRISTMAS LECTURES

The I.E.E. North-Western Centre is arranging for a lecture for older school children to be given during the Christmas holidays. The title of the lecture, which will be delivered by Dr. R. G. Conway, of the Jodrell Bank Experimental Station, is "Space Research by Rocket and Satellite." It will be given at Bolton Technical College on 3rd January; Manchester College of Science and Technology on 5th January; and Peel Park Technical College, Salford, on 7th January, commencing at 3 p.m.

This year's Christmas Lectures at the Royal Institution, London, will be entitled "Seeing the Very Small." The six lectures—the 131st course in the series—will be given by Dr. V. E. Cosslett, of the Cavendish Laboratory, Cambridge, on 29th and 31st December, and 3rd, 5th, 7th and 10th January at 3 p.m.

By-Pass Lighting

Surrey Highways and Bridges Committee has reported that all the lighting authorities concerned except Surbiton are prepared to provide a modern system of lighting for the Kingston By-Pass. Surbiton Council says that it cannot find the money because it is so heavily committed in lighting other roads in the borough.

In discussions on the lighting of the By-Pass, the Ministry of Transport has suggested that 200 W sodium lamps mounted at a height of 35ft and spaced 170ft apart should be used.

South Wales Switchgear Orders

Among export orders recently completed by South Wales Switchgear, Ltd., was a switchboard for Montego Bay for the Jamaica Public Service Company. This, a four-panel board of the S.W.S. single-busbar, air-insulated, outdoor weatherproof design, was supplied on very short delivery; the order was received in June and the board was dispatched at the end of October. Three further orders from the Jamaica Public Service Co. were received by South Wales Switchgear in November. One was for eighty dual ratio transformer (5 kVA to 100 kVA); another was for a 350 MVA single-busbar, air-insulated, outdoor weatherproof Type D8X oil circuit-breaker unit; and the third for two 3-panel, single-busbar, outdoor weatherproof pattern isolator boards for 350 MVA service at 13·8 kV.

Three 333 kVA and three 500 kVA single-phase 12,000/120 V transformers are being supplied to the Trinidad and Tobago Electricity Commission for the new Hilton Hotel at Port of Spain, Trinidad.

PUMPING MACHINERY CONTRACT

Pretoria City Council has awarded a contract for the circulating-water pumps for its Rooiwal power station to Dowson & Dobson, Ltd., the South African agents for W. H. Allen, Sons & Co., Ltd. The contract, valued at £104,751, is for three Allen 54in horizontal - spindle double - suction pumps driven by 1,150 h.p. motors.

Winter Prospects in Kent

LAST year certain emergency works were undertaken to ensure maintenance of electricity supply in the Kent area. *Regional Power* (the magazine of the Eastern, London and South Eastern Region of the Central Electricity Generating Board) says that this winter finds the Board still without the planned 275 kV connections and with the East Kent load still rising there is again cause for anxiety. The section from Canterbury to Newington, near Sittingbourne, is nearing completion and arrangements are being made to energise it at 275 kV through one of the supergrid transformers on site at Canterbury. This will be connected to the 132 kV grid and will provide the equivalent of a "condenser" of 17 MVAr capacity.

The absence of the projected Thames Crossing means that more power must be imported into the South Eastern Division at the supergrid point at West Weybridge where it is proposed to install a third 275/132 kV transformer as a stand-by in case one of the existing units goes out of service. With these and other provisions it is hoped to meet the winter load.

FLUORESCENT LAMPS

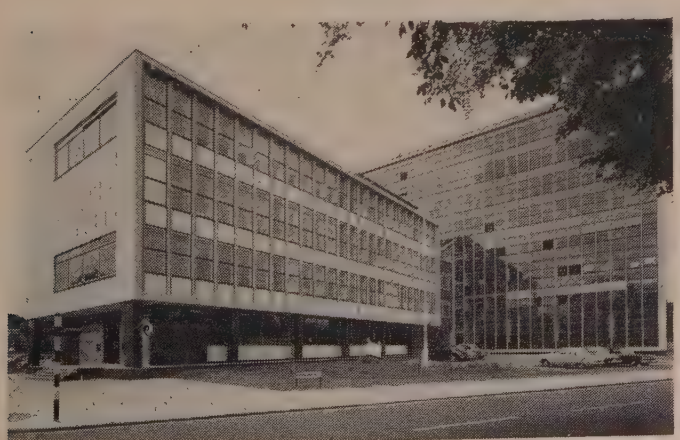
THE 1956 edition of British Standard, B.S. 1853, "Tubular Fluorescent Lamps for General Lighting Service," covered tubular fluorescent lamps used in switch-start circuits only. The standard has now been revised and covers lamps suitable for use both on switch and switchless start circuits. It also includes requirements for 80 W lamps with bi-pin caps and 125 W lamps with bayonet and bi-pin caps. As in the previous edition, the arrangement of the clauses is similar to that adopted by the International Electrotechnical Commission (I.E.C.) for standards for electric lamps. The quality levels are controlled by the proportion of lamps in a batch falling outside prescribed limits. The foreword to the standard states that "lamps falling outside the specified quality levels are not necessarily failures or faulty lamps, but their numbers serve to determine the level of quality." The standard specifies technical requirements and also methods of test for determining the quality and interchangeability of the lamps. Copies (7s 6d) may be obtained from the British Standards Institution, 2, Park Street, W.1.

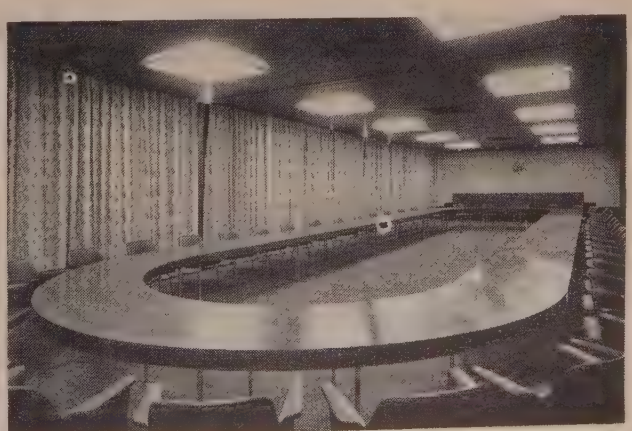
Mining Circuit-Breakers

A specification (No. 209/1960) has been published by the National Coal Board, Hobart House, Grosvenor Place, London, S.W.1, for 200 A medium-voltage flameproof air-break circuit-breakers for underground use. It covers breakers for use on three-phase 50 c/s circuits up to 650 V and supersedes specification No. P7/1950. Additional requirements relating to the design of the isolator have been specified and there is an additional clause on electrical interlocking. Type testing and inspection have also been introduced.

Chamber of Commerce House, Birmingham

In the new Birmingham Chamber of Commerce building, opened by the Paymaster General (Lord Mills) on 3rd December, lighting is of a higher than average level (30-35 lumens/sq ft). Most of the fittings were supplied by the General Electric Co., Ltd., including a number of specially designed semi-recessed fluorescent units, as in the Council Chamber (right). Two subsidiary companies, the Express Lift Co., Ltd., and Reliance Telephones, Ltd., were responsible for the lifts and the transistorised loud-speaking internal telephone system. The electrical installation was carried out by Parker, Winder & Achurch, Ltd., the switchgear, cable, conduit and skirting trunking being supplied by the G.E.C.





INDUSTRIAL NEWS *[continued*

Electrical Engineers' Exhibition

A NUMBER of matters relating to the organisation and running of the Electrical Engineers' Exhibition are contained in a report of the Exhibitors' Consultative Committee, signed by the chairman, Mr. W. S. Boone. The organisers of the exhibition held a postal ballot of exhibitors earlier this year on the subject of sectionalisation. The Committee subsequently circulated for comment a scheme put up by one exhibitor. Although the response was very good there was a wide division of opinion on the subject. There was a majority in favour of sectionalisation but the Committee decided that it was too small to warrant an approach to the organisers on the matter. Therefore no further action will be taken until there is a much stronger demand for sectionalisation.

Used Appliance Allowances

A second edition of its booklet, "Used Electrical Appliance Allowances," has been produced by the N.E.C.T.A., Ltd., 14, Bedford Row, London, W.C.1. This sets out the original prices of domestic electrical appliances of many makes and the dates of their introduction and suggests the allowances which should be made when the appliances are taken in part exchange for new ones. Copies are available from the Association at 5s 6d.

Running Cost of All-Electric Flats

Mr. E. J. Parnall, assistant chief commercial officer with the North Eastern Electricity Board, addressing members of the Northumberland and Durham Local Authorities Clean Air Committee, referred to the all-electric flats built by South Shields Corporation at Laygate. The equipment of each flat, he said, included a cooker, water heater, clothes dryer and a washing machine, with floor warming in the living-room and hall. A preliminary calculation now that the flats had been in use for a year showed that the average all-in weekly cost was about £1.

ELECTRICIANS' POCKET BOOK

The 1961 edition of "The Practical Electrician's Pocket Book" has been published by *Electrical & Radio Trading*, 6, Catherine Street, London, W.C.2. This 530-page book contains over 30 articles giving explanations and practical guidance on many aspects of the electrician's work. Such subjects as refrigerators, motors and portable tools are included; in addition there is an outline of the function of the National Inspection Council and an article on recent developments in electrical engineering.

New features are an account of automatic control in industrial processes, automatic oil-burning space-heating units, motor maintenance, transformers, wireman's tools and accessories and staff location systems, while the sections on domestic appliance repairs, lighting, power factor correction, space heating and instruments have been revised. The book is priced at 7s 6d.

H.P. Restrictions and Appliance Sales

IN a statement last week the British Electrical and Allied Manufacturers' Association points out that the severe falls in manufacturers' deliveries of domestic appliances in the third quarter (see table) were as much due to the temporary boom following the sudden removal of hire-purchase restrictions in October, 1958, as to their partial reimposition in April this year. Deliveries during the third quarter of 1959 were exceptionally high and the present figures reflect the acute dislocation of production caused by "both edges" of the hire-purchase weapon.

The B.E.A.M.A. also points out that last year's release of pent-up demand caused imports of appliances to rise from £5·1 million in 1958 to £11·9 million in 1959 and numerous foreign manufacturers were able to gain a foothold in the U.K. market which they are now very reluctant to lose. Although U.K. export deliveries show encouraging increases these do not have sufficient impact on total output to enable manufacturers to combat the loss of economies of large-scale production caused by the contraction of the home market.

It is in the light of such facts that the B.E.A.M.A. is pressing the Government to adopt a 10 per cent deposit with repayment over three years for major appliances at present subject to 20 per cent deposit and two years, and then to retain these arrangements without alteration for as long as possible.

MANUFACTURERS' DELIVERIES OF DOMESTIC ELECTRICAL APPLIANCES FOR JULY-SEPTEMBER, 1960

	HOME			EXPORT			TOTAL		
	Number 000s	Value £000	Value % Change on corresponding period of 1959	Number 000s	Value £000	Value % Change on corresponding period of 1959	Number 000s	Value £000	Value % Change on corresponding period of 1959
Washing machines with electrically driven means of agitation									
(a) those with hand or power wringers	68	2,469	−63	19·3	509·1	+ 10	87	2,978	−58
(b) those combined with a spin dryer	91	4,740	− 7	35·6	1,152·5	+ 60	127	5,893	+ 1
Wash boilers (up to 10 gal)	47	321	−15	0·3	2·5	− 7	47	324	−14
Spin dryers	16	242	−77	4·9	61·5	− 48	21	304	−74
Heated tumbler dryers	3	91	−46	2·5	57·2	+1171	6	148	−14
Irons (a) non-automatic	49	34	−15	14·9	9·9	+ 52	64	44	− 4
(b) automatic	490	878	+ 2	131·0	194·1	− 6	621	1,072	+ 0·3
Vacuum cleaners	241	3,286	−28	73·4	642·9	+ 63	314	3,929	−21
Floor polishers and scrubbers	5·3	76	+12	15·1	132·3	+ 5	20	208	+ 7
Electric refrigerators*	144	n.a.	n.a.	25·6	n.a.	n.a.	170	n.a.	n.a.
Cookers (a) below 5 kW	27	326	− 4	1·7	14·5	− 13	29	341	− 4
(b) 5/12 kW	120	4,241	+19	4·3	114·6	+ 22	124	4,356	+19
Food and drink mixers up to 3 quarts capacity including all hand held ...	35	402	+28	21·4	244·2	+ 19	56	646	+24
Toasters	39	119	−23	17·9	55·1	− 6	57	174	−19
Water heaters									
(a) Immersion up to 3 kW	207	317	+ 6	4·0	7·3	+ 9	211	324	+ 6
(b) Storage up to 30 gal	39	419	+ 6	3·0	36·8	− 35	42	456	+ 1
Space heaters up to 3 kW	759	2,974	+29	23·7	78·4	+ 20	783	3,052	+29
Electric blankets	558	1,442	+47	2·3	5·6	− 16	560	1,448	+47
Hand hair dryers	106	192	− 4	18·7	34·4	+ 99	125	226	+ 4
Dry shavers	283	1,048	+ 5	114·3	213·9	− 11	397	1,262	+ 2

* Supplied by the Domestic Refrigeration Development Committee.

n.a. = not available.

Mutac Clipper switches have been accepted by the Council of Industrial Design for Design Index—so architects, consulting engineers and contractors are choosing them for their good looks, as well as for their functional efficiency and easy assembly.

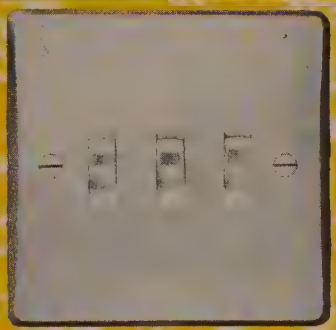
just a minute!

that's all it takes to instal the

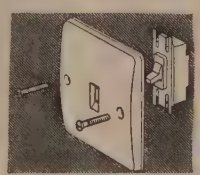
'MUTAC CLIPPER'

ARCHITRAVE SWITCH ASSEMBLY

PLASTER DEPTH SWITCH ASSEMBLY



Take either a 'Mutac Clipper' plaster depth or architrave switch plate and select the required switch, bell push or pilot light. Simply press home the spring clip with a small screwdriver and a fixed plate assembly is ready for installation. Available in 1, 2 or 3 gang for plaster depth and 1 and 2 gang for architrave. 'Mutac Clipper' switch assemblies will cut installation costs and save time as additions and alterations can be made with the minimum of effort.



G.E.C. INSTALLATION EQUIPMENT GROUP

THE GENERAL ELECTRIC CO. LTD., MAGNET HOUSE, KINGSWAY, LONDON, W.C.2

SWITCH AND FUSE GEAR
H.R.C. FUSES
OVERHEAD BUSBARS
RISING MAINS
CONDUIT
PIRELLI GENERAL CABLE
CABLE TRUNKING
UNDER-FLOOR CABLE DUCTS
ELECTRIC WIRING ACCESSORIES
BELLS

Greater safety for hands

With new Shell Dromus Oils

Most modern soluble cutting oils contain phenolic compounds used as coupling agents between the oil and the emulsifier, for better blending and easier mixing. These phenolic compounds can cause skin irritation, especially where modern high-speed machines are used and the emulsion can concentrate, through the evaporation of water, above the safety level.

Shell research chemists have been working on this problem, which has been causing some concern to Management. After considerable research, Shell Dromus Oils have been reformulated and these new cutting oils now produce bland emulsions, which considerably reduce the risk of skin trouble to operators.

The real difficulty was to find a new coupling agent to replace the phenolic compounds, and Shell finally used what their chemists know as a higher fatty alcohol complex. This solved one problem, but presented another. The new coupling agent was volatile at the high temperatures normally used in blending processes. Further research found a solution to this problem by designing and installing new plant.

The new Dromus Oils are every bit as efficient as before and cost no more. They put Management in the welcome position of being able to minimise working hazards at no extra cost. And machine men need no longer be so worried about skin troubles.

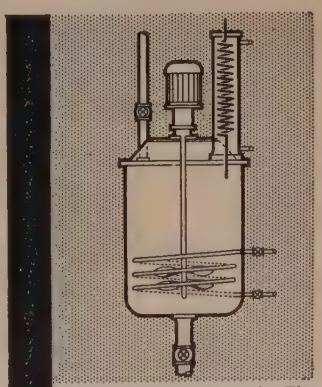
The moral of the story is that Shell research is supremely applicational. The centre at Thornton is always ready to work with even the most specialised sectors of industry to produce the right oil for the job. If you and your organization have any major lubricating problems, it pays to get in touch with your local supplier of Shell Industrial Lubricants.

The Research Story

Shell chemists in the U.K., in Holland and in the U.S.A., prepared and examined hundreds of experimental soluble oils, and established that certain combinations of fatty alcohols could be used in place of phenolic compounds with no loss of efficiency. They set to work to discover the best combination and developed a higher fatty alcohol complex which fitted exactly. Then they realised that to blend this new coupling agent into soluble oils would require special plant and new blending techniques.

Exhaustive testing of blend stability, emulsion stability, anti-corrosion and machining properties led to selection of the most promising blends. A pilot plant was set up to produce batches of these for use in field trials.

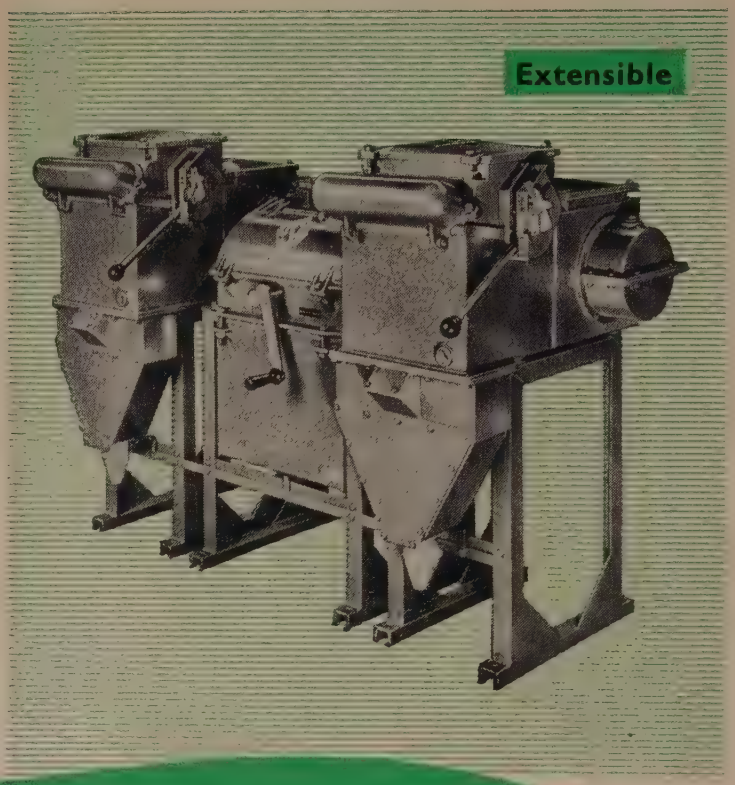
This field testing and final development proceeded for two years whilst production plants were erected at points so chosen as to give the most economical and rapid delivery throughout the United Kingdom.



This is the blending kettle. The reflux condenser beside the stirrer motor prevents the loss of constituents volatile at the blending temperature.

NEW SHELL DROMUS SOLUBLE CUTTING OILS

another proof of Shell leadership in lubrication



RING MAIN TEE-OFF

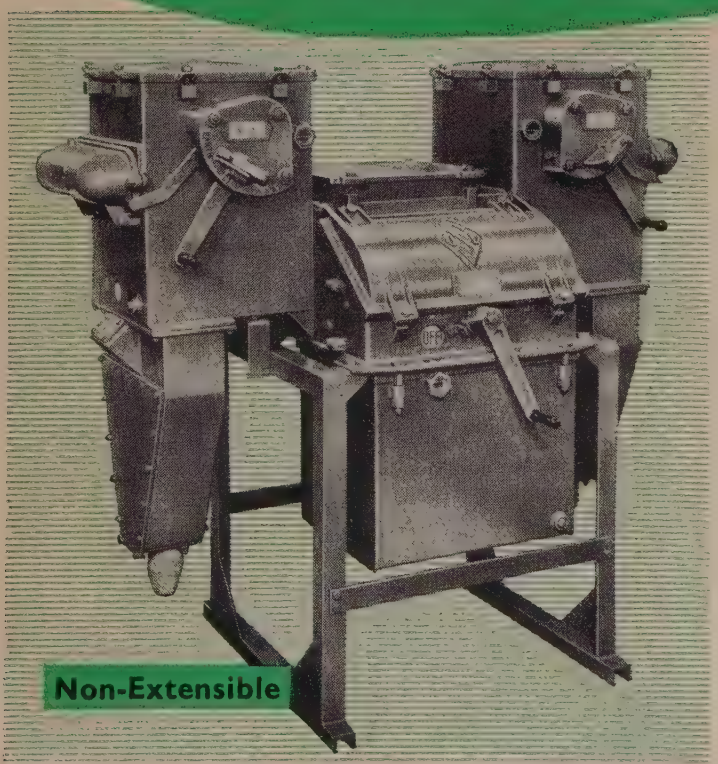
Rupturing capacity 250 MVA ASTA. Tested at both 6.6. and 11 kV with fault making load breaking Isolators.

Impulse tested

Rust proof finish if required for outdoor installation.

Many different arrangements available including transformer mounting and for incorporation in switchboards with Oil Circuit Breaker Units.

H.V. FUSE SWITCH EQUIPMENT



The following can be fitted if required:

Spare fuse container. Ammeter. Potential indicator. Shunt trip. Earth Leakage trip. Earthing and/or testing device for Fuse Switch. Metering Unit with Voltage and current transformers.

Leaflets Nos. 555 and 556 available to bona-fide applicants.

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INDUSTRIAL NEWS *[continued*

A.E.I. and G.E.C. Glass Company

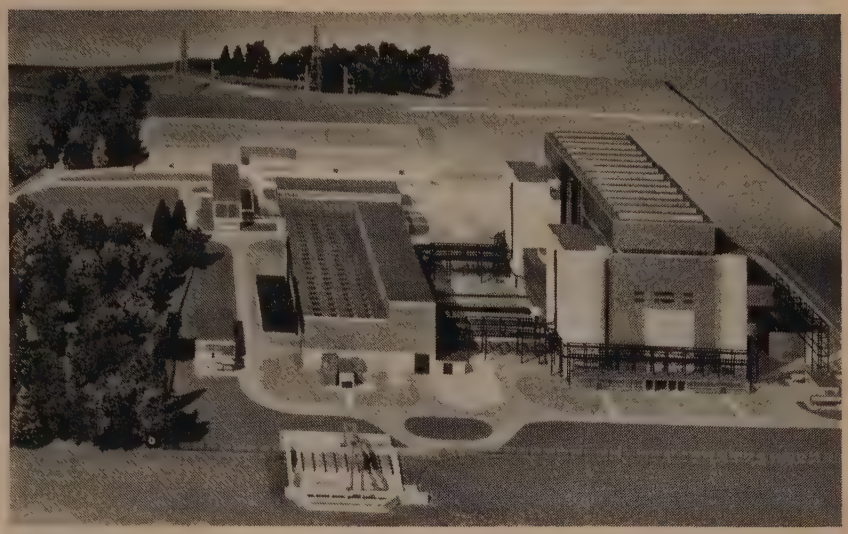
A NEW company is to be formed to take over the glass manufacture and glass sales of the A.E.I. Lamp & Lighting Co., Ltd., and the General Electric Co., Ltd. In a statement announcing this it is pointed out that the step is in line with past policy. In 1946 a jointly-owned company, Glass Bulbs, Ltd., was formed to put the manufacture of the popular sizes of lamp bulbs on a more economical basis, with a new factory at Harworth equipped with modern plant.

The new company will probably be formed early in 1961 and will take over all the glass manufacture of the two companies (other than that covered by Glass Bulbs, Ltd.) including the A.E.I. Lamp & Lighting Co. glass works at Chesterfield, and the G.E.C. glass works at Lemington-on-Tyne and Wembley.

A three-year plan provides for the development and expansion of the Chesterfield glass works at an estimated cost of £1 million, and the Lemington factory is to be further developed as a special glass hand-fabricating factory.

It is possible that some redundancy may be caused, but this will not happen in the immediate future and probably not until 1962. Every effort will be made to find suitable employment within the organisations of the two companies if the jobs of staff or workpeople are affected.

Sizewell Nuclear Project



This photograph of a model of the Sizewell nuclear power station shows the turbine hall on the left, the reactor building flanked by its boilers to the right and the indoor switchgear building in the background. In the foreground is the sea-water pumphouse. The 580 MW station is being built for the C.E.G.B. by the English Electric, Babcock & Wilcox, Taylor Woodrow Atomic Power Group

Boiler Plant for India

TWO orders for steam plant for India have recently been received by Clarke, Chapman & Co., Ltd. The first is for a coal-fired bi-drum boiler unit for the extension of the Hussainsagar power station, Hyderabad, Andhra Pradesh. The other is for a specially designed bi-drum boiler unit capable of being fired in four ways—by coal, oil, coal and bamboo sawdust or oil and bamboo sawdust. It will be installed at the new Gwalior Rayon Silk Manufacturing (WVG), Ltd., factory at Kerala which will be producing pulp from bamboo.

NEW E.D.A. FILMS

A PREVIEW of the latest film productions of the Electrical Development Association was given in London last week at a gathering of Press representatives. The first two films, Nos. 6 and 7 in the E.D.A. Educational Film Series, take the place of older films. One deals with the modern electric refrigerator and is in four parts, each self-contained. Part I covers the fundamental principles of refrigeration, while the construction and working of the compressor type refrigerator are dealt with in Part 2. Other parts describe the principles and operation of absorption models and the best ways of placing food in the cabinet. The complete running time for the film is 25 minutes.

A still from the E.D.A. film "Time to Come"

The second film, on electric cookers, shows in a very clear manner how they operate. Such features as the "auto-timer" control and infinitely variable boiling plate control are described in clear non-technical language and use is made of animated diagrams. The running time is 16 minutes and this and the refrigerator film are available in 16 and 35 mm sizes, black and white only.

A third film, in colour, is an E.D.A. promotional film designed to present the modern method of cooking. Entitled "Time to Come," it portrays a grandmother, traditionally conservative in her outlook, who not only solves her problem of finding time to enjoy herself but also steals a march on her daughter by installing an automatic electric cooker. Much of the 25 minutes' running time of this film is given over to extolling the virtues of the electric cooker and this it does in a way which is both entertaining and educational.

Copies of all the films shown are available on free loan from the Association, 2, Savoy Hill, London, W.C.2.

other duties, he will edit the company's international house magazine, *The Announcer*.

The board of A. Reyrolle & Co., Ltd., has co-opted the company's chief engineer, **Mr. W. Gray**, M.I.E.E., A.M.I.Mech.E., as a director. Mr. Gray joined the engineering department in 1929, and was eventually appointed engineer-in-charge of the Protection and Control Unit. He became chief engineer in 1958.

Mr. W. Gray

Owing to ill-health **Mr. William Hill** has resigned from the office of sales director of Burco, Ltd., as from 30th November. The company's sales and sales personnel are now controlled by **Mr. Kenneth B. Holman**, general sales manager.

Mr. Philip V. Summer announced last week his intention of retiring from the chairmanship of Dictograph Telephones, Ltd., in June next year. He will remain a director.

Goblin (B.V.C.), Ltd., have announced the following appointments in their Domestic Appliance Division:—**Mr. A. E. Sutton**, sales manager; **Mr. L. C. Sharp**, field sales manager; **Mr. E. H. Turney**, service manager; and **Mr. J. R. Ball**, contracts manager.

The annual general meeting of the North Metropolitan Branch of the **Electrical Industries Benevolent Association** will be held at Northmet House, Southgate, N.14, on Thursday, 9th February, at 3 p.m. Nominations for officers should be submitted to the hon. secretary, Mr. A. T. Durbridge, Electricity Offices, 40, Church Street, Enfield, Middlesex, not later than 2nd February. The Branch annual dinner/dance has been fixed for 21st April at St. Albans.

OBITUARY

Mr. W. W. Cook.—The death is reported of Mr. William Wilson Cook, M.I.C.E., M.I.E.E., at Lymington, Hants, at the age of 93.

WILLS

Mr. J. Rankin, O.B.E., late deputy chairman of the Merseyside and North Wales Electricity Board, who died on 9th October last, left £28,266 gross (£27,775 net).

Air Marshal Sir Raymund G. Hart, director of the Radio Industry Council and one of the pioneers of radar, who died on 16th July last, left £17,240 gross (£13,759 net).

Lieut.-Col. A. F. H. S. Simpson, C.M.G., O.B.E., late deputy managing director of Marconi's Wireless Telegraph Co., Ltd., and the Marconi International Communication Co., Ltd., who died on 2nd October last, left £73,387 gross (£69,942 net).

E.R.A. Appointments

THE Electrical Research Association announces that **Mr. L. Gosland**, B.Sc., M.I.E.E., has been appointed deputy director. This appointment is additional to his position of research manager which he will continue to hold. **Mr. C. G. Garton**, F.Inst.P., M.I.E.E., and **Mr. E. W. Golding**, O.B.E., M.Sc.Tech., M.I.E.E., M.Amer.I.E.E., M.I.B.A.E., are appointed assistant directors of the E.R.A. Mr. Garton will continue as head of the materials department and Mr. Golding will continue as head of the rural electrification department and also as the overseas liaison officer.

Mr. Gosland was educated at Tain Royal Academy, Ross-shire, and Glasgow University. He received his electrical training with Barr & Stroud, Glasgow, and joined the E.R.A. in 1925. He is chairman of the Commission Mixte Internationale pour la Protection des Lignes de Telecommunications et des Canalisations Souterraines (C.M.I.); chairman of the C.I.G.R.E. Study Committee on Radio and Telephone Interference; and has served on the Committee of the Supply Section of the Institution of Electrical Engineers. Before becoming research manager of the E.R.A., Mr. Gosland was head of the switchgear department and on the death of Dr. Whitehead he became joint acting director of the Association.

Mr. Garton was educated at the Rugby College of Technology and received his industrial training with the British Thomson-Houston Co., Ltd. He was with the All-Union Electrotechnical Institute, Moscow, from 1933 to 1937 and joined the E.R.A. in 1937. He is the present chairman of the Measurement and Control Section of the I.E.E.

Mr. Golding was educated at the Manchester College of Technology and received his early training with Metropolitan-Vickers. He has been with the E.R.A. since 1945, having previously been a lecturer in the Electrical Engineering Department of Nottingham University. Mr. Golding is a member of the Arid-Zone Panel of the Royal Society-U.N.E.S.C.O. Committee and is particulary interested in the energy needs of underdeveloped and other remote areas. He is the author of "Electrical Measurements and Measuring Instruments" and of other books on electrical engineering subjects and has travelled extensively.

Mr. L. Gosland

Mr. C. G. Garton

Mr. E. W. Golding

Design Course for Junior Engineers

A design appreciation course for apprentices and junior engineers arranged by the Council of Industrial Design is to be held in March and April next at Reigate in two residential periods, each of four days, separated by an individual study period of four weeks. The cost is 35 gns for each student, exclusive of travelling. Two similar courses have already been run by the Council—one for Hoover, Ltd., and another, just completed, for 15 engineers from nine firms. The residential periods include visits to factories, the design centre, and schools of industrial design (engineering). Requests for further information should be addressed to Miss Sydney Foott, Education Section, C.o.I.D., 28, Haymarket, London, S.W.1.

WELDING HANDBOOK

A 56-page booklet, "Weld-ability," produced by the Welding Division of the English Electric Co., Ltd., East Lancashire Road, Liverpool, contains many suggestions for better welding. A number of simple diagrams are included. The first half deals with the principles of good welding, detailing the necessary equipment and types of welds, explaining terms, symbols and British Standards. The second part covers the company's arc welding electrodes and equipment. The purpose of each is clearly explained and there is a section at the end on welding troubles, their cause and cure.

Transformer Manufacturers' Agreement

ELECTRICITY SUPPLY WITNESSES GIVE EVIDENCE

THE Restrictive Practices Court, which is considering whether a price-fixing agreement between members of the Transformer Manufacturers' Association is in the public interest, last week began hearing evidence on behalf of the Registrar of Restrictive Trading Agreements.

Mr. Megaw, Q.C., concluding his opening address for the Registrar, said that it had been alleged that, if the price agreement were terminated, there would be a decline in the quality of transformers and substantial reductions in expenditure by firms on research. It was contrary to common sense, however, to suppose that either of those two possibilities would occur. If there were competition, it would intensify the desire of manufacturers to advance in technology, so that they could produce better transformers at lower prices and thereby obtain a greater share of the market. Firms would have to spend as much money as at present on research and they would need to preserve the quality of their goods if they wished to remain competitive.

The detriment flowing from the agreement arose from the way the restrictions had been used, were being used, and were likely to be used to stifle the competition of non-members. Area Boards buying small transformers from Association members were given a special rebate so as to induce the Boards not to buy from non-members; the effect of the collective rebate was to drive the prices of small transformers to a low level, but no rebate was given in the case of large transformers, where prices were rather high and in which there was no competition from non-members. The Association subsidised its price war with non-members from the sales of small transformers by charging the public higher prices for large transformers.

Electricity Supply Witnesses

Mr. C. T. Melling, a member of the Electricity Council, Mr. J. L. Egginton, chief transmission engineer, Central Electricity Generating Board, and Mr. L. F. Miller, chief purchasing and contracts officer, Central Electricity Generating Board, were the first witnesses to give evidence for the Registrar. They all said that in their view although there would be reductions in prices were the agreement to be abrogated, there would not be the violent price falls that marked the beginning of a price war. It was untrue to say that the supply authorities could exert pressure on manufacturers and drive prices down by threatening to withhold orders or by delaying placing orders because of the great demand for electricity supply which they were under a statutory duty to satisfy. The main complaint that they had was that they did not know whether the prices charged by the Association were fair, because they were unable to see the detailed costings of the members. All that the Association had been willing to disclose were the average profit figures of their members; but it was quite impossible to deduce from the average profit made on all sizes of all makes of transformers whether the prices charged for particular transformers were reasonable.

Tendering Practice

Mr. Egginton, describing the Board's practice of purchasing transformers, said that for small transformers they invited a number of tenders from both members and non-members, for fairly large transformers they invited tenders from one non-member and two members whom they selected, for a large transformer they allocated the contract to one member whom they selected. The witness agreed that he had told manufacturers that he could not understand how they were able to sell small transformers at such low prices. Mr. Miller said that though price was the dominant factor in deciding whether to accept a tender, it was not decisive. Technical features and transport difficulties were also considered and special measures might be taken to keep firms in existence if there was a danger that without them there would be too little competition. The Board regularly obtained figures of available capacity from manufacturers, and when accepting tenders paid regard to that factor. If there was a risk of capacity being lost because firms could not continue in business at uneconomic prices, he felt that the Board would act to maintain the capacity that they thought should be preserved.

Mr. E. Long, member of the Central Electricity Generating Board, specifically responsible for finance, in giving evidence for the Registrar said that it would not pay the Board to accept uneconomic prices and that the Board would take action to correct an unreasonable level of prices.

Until this case had begun, he had not known that prices of small transformers were uneconomic. The fact that prices for small transformers were low had not "registered in his mind." Since the case he had become interested in transformers and now realised that on the face of it prices for small transformers were unprofitable. Asked what action the Board would take to correct this, the witness replied that the Board would not take any action. Were the same thing to happen with larger transformers the Board might take action because there was a smaller area of supply in larger transformers. Mr. Long thought that a reasonable overall profit would be a minimum return of 15 per cent on capital employed and he agreed that the Association's accountant's view of a 20 per cent return on capital employed was reasonable. He also considered that manufacturers of larger transformers were entitled to greater profit because they provided greater facilities for research and technical development than other manufacturers.

Joint Scheme Suggested

Mr. Long said that the best arrangement for the industry would be a joint scheme between the Board and the Association whereby they would agree on a minimum rate of profit for the manufacturers and maximum prices to be paid by the Board, and whereby if manufacturers made more than a certain fixed amount of profit they would share the surplus profit with the Board. On the face of it, there was a serious risk of price cutting if the agreement ended, but he did not consider the risk would materialise.

Non-member firms, Mr. Long continued, were expanding and were prosperous. Asked how he knew, the witness stated that he had no personal knowledge about this, but he had accepted the advice of Mr. Miller to this effect. Mr. Miller had not given evidence on this matter, because it was felt, as a matter of policy, that he (the witness) should give this evidence.

Mr. Justice Russell remarked that it came to this: the witness simply put someone else's evidence in his proof of evidence as a matter of policy.

Evidence was then given by representatives of Area Boards. They each

said that their buying policies were their own and that they did not collaborate with one another on prices. Purchases were made after tenders had been invited from a number of firms some of whom were not members of the Association. Some Boards only invited tenders from firms whose factories had been inspected by the Boards. All placed great emphasis on quality and in deciding whether to accept a tender they had regard to quality and delivery dates as well as price. It was the policy of most Boards to place contracts with several manufacturers so as to spread the work and avoid being dependent on a single source; most of the Boards dealt with members of the Association and non-members, although in recent years non-members had generally managed to obtain an increased share of the orders for small transformers. In the case of the South Western Board, substantially the whole of its business had been placed with non-members.

The following persons gave evidence on behalf of their respective Area Boards: Mr. J. D. Nicholson, chief engineer, Yorkshire Electricity Board; Mr. W. E. Gibbs, chief engineer, South Eastern Electricity Board; Mr. R. B. Sully, purchasing officer, Southern Electricity Board; Mr. A. H. Proctor, assistant chief engineer, South Western Electricity Board; Mr. L. G. Turner, purchasing officer, Midlands Electricity Board; Mr. P. d'Eyncourt Stowell, chief engineer, Merseyside and North Wales Electricity Board; Mr. W. S. Kelly, purchasing officer, Eastern Electricity Board; Mr. H. Esther, chief engineer, North Eastern Electricity Board; and Mr. J. E. Peters, chief engineer, North Western Electricity Board.

Evidence was then given for the Registrar by representatives of firms which were not members of the Association. They were Mr. J. Carmichael, general manager, Norman Isherwood & Co., Ltd.; Mr. S. R. B. Brewer, director, Bryce Electric Construction Co., Ltd.; and Mr. F. B. Lydall, managing director, Yorkshire Electric Transformer Co., Ltd. The last two witnesses said that the low prices for small transformers, which had made conditions for the industry difficult, stemmed from two causes: firstly, premature expansion of capacity by some of the larger members of the Association establishing new factories when there was insufficient demand; and, secondly, the introduction by the Association of its rebate scheme to Area Boards which compelled non-members to depress their prices.

Mr. T. W. Bailey, managing director of the Lindley Thompson Transformer Co., Ltd., another non-member of the Association, gave evidence that prices for small transformers sold by his company were still sufficient to give it a small profit. In 1955-56 his company sold 500 kVA transformers at £810-820; in 1958 the price went down to £770, and the current price, which was the lowest price at which his company would be prepared to sell, was £675. Below that price sales became uneconomic. The witness agreed that his company specialised in making a few sizes, and that it had exceptionally low selling costs.

Two representatives of the National Coal Board, Mr. B. L. Metcalf, B.Sc., M.I.Mech.E., director of engineering, and Mr. S. W. Bennett, deputy director-general of the purchasing and stores department, gave evidence about the Coal Board's purchases of transformers. They did not find any appreciable difference in the quality of transformers sold by non-members and members of the Association.

Professor F. W. Paish, M.A., of the London School of Economics and Political Science, Professor of Economics in the University of London, did not think that the abrogation of the agreement would harm the industry. In his view, excess capacity in the industry was due to the Association keeping prices unwisely high for small transformers, so encouraging independent manufacturers to enter the industry. However, it was a temporary phenomenon; within two to four years the excess capacity would be absorbed by the rising demand. The witness agreed that in the export market there was a fluctuating demand, but said that in the long run it was a market capable of indefinite expansion.

The hearing of evidence was concluded. Counsel will make their final addresses next week.

Parliamentary Report

THE Parliamentary Secretary to the Ministry of Aviation (Mr. Rippon) in a written reply has said that the Ministry proposed shortly to issue tenders for the development of equipment to record and preserve essential data in the event of an aircraft accident. The specification had been drawn up in consultation with the Air Registration Board and civil users and should be suitable for both civil and military aircraft. A number of recording devices were already available and employed on appropriate occasions in both civil and military aircraft, particularly during flight testing.

Colour Television

The Postmaster General (Mr. Bevins) said he would shortly be replying to the B.B.C.'s request for permission to start an experimental public colour television service in November, 1961. The Television Advisory Committee had advised him against the introduction of colour television in the near future because it was being discussed by the Pilkington Committee.

This policy was described by Mr. W. R. Williams, a Labour member, as unimaginative and unfair. Why should the B.B.C. be forced to mark time simply because other interested bodies were either unwilling or unable to do the research? Would not this unfortunate decision mean that shortly Britain would be lagging behind?

Mr. Bevins replied that he appreciated what the B.B.C. had already done but it would be a profound mistake to make a decision on colour television in advance of a decision on line standards. That would encourage a demand for the existing type of set with colour which might well be obsolete in a few years. There was some misapprehension about progress in other countries. He was told there was a very small number of colour sets in the United States and that in Japan the cost of such a set was £500. The B.B.C.'s representative on the Advisory Committee had signed the report which recommended that colour television should not be introduced in the near future.

Answering a later question, Mr. Bevins said he hoped the Pilkington Committee would report by the end of 1961 or early in 1962. He was loth to ask them for an interim report on a particular part of their investigation but he was sure that if they felt it right to make one, say on line definition, they would not hesitate to do so.

London-Midland Electrification

The Minister of Transport (Mr. Marples) said that the British Transport Commission's reassessment of the London Midland electrification scheme involved a further expenditure of £138 million. The reassessment was under urgent examination and the Commission had recently provided a statement of the proposed phasing of the expenditure up to 1966. He was as anxious as anyone to reach a decision but a scheme of this magnitude must be related to the other items in the four-year programme of railway modernisation on which the Commission had been engaged and which he expected to receive shortly.

Financial Section

STOCKS and SHARES

UNLESS there is an unexpectedly early easement of the credit squeeze, Stock Exchange markets seem likely to end the year in a cautious mood, with gilt-edged stocks near their lowest recorded levels and industrials on an average some 12 per cent below prices ruling in the period of high optimism twelve months ago. Some sections of the electrical markets have been steadied recently by reassuring statements from the chairmen of E.M.I. and Plessey on the subject of their companies' trading results over the past few months. On the other hand, the latest statistics issued by the British Electrical and Allied Manufacturers' Association give further evidence of the extent to which sales of some domestic appliances have been affected, and of the difficulties created for the manufacturers, by repeated changes in the hire-purchase regulations. Generally, however, share prices have been fluctuating within narrow limits in very quiet business conditions.

I.C.T. Results

An increase in the final dividend from International Computers & Tabulators had not been expected, so that the price of the £1 shares was initially marked up several shillings, to 63s, after the declaration of a final payment making 11¼ per cent for the year ended in September, against 10 per cent previously. Later, there was a partial reaction to 61s 3d. Comparison of the profit of £2·9 million with the 1958-59 figure of £2·3 million is affected by the fact that the former includes this time a contribution from Powers-Samas for a full year, instead of nine months. Nevertheless, the extent of the improvement made a good impression. It provides cover of 2¾ times for the new rate of dividend, on the basis of which the yield on the shares goes up to about 3¾ per cent.

Combined Electrical

Combined Electrical Manufacturers, formed last August to effect the merger of Hackbridge & Hewittic and Switchgear & Cowans, are making their first dividend payment in the form of an interim distribution of 4 per cent on account of the year ending next March. In an accompanying statement, the directors report that combined profits are being maintained in accordance with estimates at the time of the merger. It was forecast then that profits of the two constituent firms together would be at an annual level in the neighbourhood of £700,000, on which basis dividends totalling 12½ per cent on the £2·1 million ordinary capital were envisaged. Earnings at the rate expected would appear to cover such a payment about twice over. The 4s shares have been dealt in recently at around 7s 9d, and offer a prospective yield of nearly 6½ per cent.

Cable Conditions

Most of the recent news from the cable manufacturing industry has brought at least a measure of encouragement to a field of investment which has been out of favour since last year's breakdown of the price structure in some main sections. Within the past month or two, Mr. McFadzean has predicted that profits of B.I.C.C. will be much the same this year as in 1959, and that the benefits of the move towards more economic price levels for power cables should become apparent in 1961. In Crompton Parkinson's annual report, Mr. Parkinson described the market generally as having acquired a basis of some stability on which reasonable profits could again be earned. Earlier, Lord Chandos was expecting marginal profits this year from A.E.I.'s cable sections, whereas in 1959 the turnround from profit to loss had made an adverse difference of £1·4 million to the group results.

Improvement Expected

Also on the subject of prospects for the cable manufacturers, the chairmen of both Johnson & Phillips and F. McNeill have this year expressed opinions, in very similar terms, that the industry had weathered the worst of its difficulties: improvement might be slow to appear but a profit-earning basis was being re-established. Of the shares most directly connected with the industry, those of B.I.C.C. have been steadier since the company's half-yearly report, although at 48s 6d they are still some 12s below the year's top price, and the yield of 5½ per cent is well above the average for leading industrial shares. Johnson & Phillips dropped out of the dividend list this year, but made a special tax-free payment. There is periodical activity at around 17s 6d in the £1 shares, which have a balance-sheet "break up" value of over 40s.

Shares and Yields

Of the big groups to whom cable manufacturing is only a part, albeit an important one, of the activities,

Publication of our weekly table of price changes in electrical investments will be resumed in the issue of 6th January

A.E.I. £1 shares at their still depressed level of 41s show a yield of as much as 7¼ per cent on the last dividend, while on Crompton Parkinson 5s shares at 11s the return is about 5¾ per cent. Cable interests of Aberdare Holdings accounted for only about one-third of the group's turnover last year: dividends of 17½ per cent have been paid for six years in succession and produce a yield of 6 per cent on the 5s shares at 14s 6d. F. McNeill, whose 5s shares are quoted at 9s 6d, paid 15 per cent last year but have reduced the current year's interim payment from 7 to 4 per cent.

Sun Electrical

Record trading and earnings were achieved by Sun Electrical (who have lately held their annual meeting) in the financial year ended in April. Net profits improved by nearly one-third to £71,000, and provided three-fold cover for dividends totalling 18½ per cent, or 3½ per cent more than the previous payments. Since the books were made up, the reimposition of credit restrictions, especially the hire-purchase regulations, was said in the annual report to have affected some classes of the business. Sales in the first half of the year had nevertheless been maintained, and although prospects were regarded as difficult to assess, the board was hopeful that the results would again produce a satisfactory return to shareholders. The yield on the 5s shares at 16s 9d works out at 5½ per cent.

Berry's Electric

Berry's Electric Magicoal, whose 5s shares have been a star performer this year in the electrical market, have called a meeting for 12th January to approve a one-for-three scrip issue. As announced previously, it is the intention to pay on both old and new shares a final dividend of 20 per cent, to make a total equivalent to 30 per cent on the enlarged capital, or one-third more than the present rate. At 48s 9d the 5s shares have retained all but a shilling or so of their big rise over the earlier part of the year, and yield 4·1 per cent on the indicated dividend. The recently marketed 5s shares of the Berry Trust have been quoted around 37s to yield a little over 3¾ per cent on the forecast dividend of 28 per cent. This company holds investments having a market value at the end of November in excess of £1 million, of which the interest in the Magicoal company accounted for 65 per cent.

REPORTS and DIVIDENDS

Camp Bird, Ltd., reports a group loss for the year to 30th April, 1960, of £163,028, after tax and transferring £278,898 profits in an investment trust to capital reserve. There is no dividend, against 20 per cent previously. The consolidated profit for the year of Hartley Baird, Ltd. (controlled by Camp Bird), before tax, but after charging amounts written off in a subsidiary, was £32,625 (£114,261), less tax £47,491 (£59,859), leaving a loss of £14,866 (profit £54,402). The fall in profits has arisen, in the main, by reason of provisions made in the accounts of a subsidiary, H. J. Baldwin & Co., Ltd., into whose affairs Hartley Baird made a special investigation. The remainder of the Hartley Baird operating companies earned satisfactory profits and are trading satisfactorily in the current year.

It is stated that H. J. Baldwin & Co., which made a consolidated net loss of £50,462, will as a result of reorganisation continue in its traditional business unencumbered "by the confusion of historical situations until now preserved in the accounts." Meanwhile the company's normal business is proceeding satisfactorily during the reorganisation of the administration and sales divisions.

Thorn Electrical Industries, Ltd., is raising £3,000,000 through the issue of 6½ per cent unsecured loan stock 1985-89. The net proceeds will be used to reduce bank overdrafts which amounted to £2,974,793 on 3rd December. The stock has been privately placed by Hambros Bank at a price of £98 per cent.

International Computers & Tabulators, Ltd.—The final dividend of 7¼ per cent (6 per cent) makes a total of 11¼ per cent (10 per cent) on increased capital for the year ended 28th September, 1960. Group profits expanded from £2,329,000 to £2,952,000 and after tax of £1,026,000 (£1,025,000) the net profit of £1,926,000 compares with £1,304,000. The balance carried forward is raised from £235,000 to £585,000.

Kenwood Manufacturing Co., Ltd., announce an interim dividend of 7½ per cent for the year ending 31st July, 1961. Group profit, before tax, for the 19 months' period ended 31st July, 1960, amounts to £42,675, including the Kenwood Manufacturing (Woking) group for the year ended that date. This compares with an estimate of about £196,000 for the period, when the merger with Peerless & Ericsson was announced last December. The short-fall in profit, which was foreshadowed by the chairman in September, was mainly due to short-term production difficulties. These are now stated to have been largely overcome and the outlook for the current year is "more encouraging." Though sales of some products have been affected by the credit squeeze the sales of the new "Chef" mixer are higher than the peak levels reached in 1959.

Range Boilers, Ltd., have purchased the whole of the share capital of A. C. Scott & Co., Ltd., and their chairman and managing director, Mr. Edward Dickinson, has been appointed chairman of that company. The existing directors and management will continue.

The Cables Investment Trust have declared an interim dividend of 10d per share (the same).

Increases of Capital

Roberts Electrical Co., Ltd.—Increased on 12th April by £9,900 in £1 ordinary shares, beyond the registered capital of £100.

Tower Batteries, Ltd.—Increased on 2nd March by £11,000 in £1 ordinary shares, beyond the registered capital of £1,000.

Flexible Lamps, Ltd.—Increased on 26th April by £50,000 in £1 ordinary shares, beyond the registered capital of £50,000.

Perdio, Ltd.—Increased on 22nd April by £19,500 in £1 6 per cent cumulative redeemable preference shares, beyond the registered capital of £30,500.

New Companies

Tele-Electric Wiring, Ltd.—Registered 5th December. Capital £1,000. Installers, suppliers and manufacturers of electrical, telecommunication and electronic equipment of all kinds, etc. Directors: R. E. Sarro, J. Sims and L. E. Sims. Secretary: R. E. Sarro. Regd. office: 72, Leighton Road, Ealing, W.13.

El-Tronics Co. (Great Britain), Ltd.—Registered 1st December. Capital £1,000. Manufacturers of and dealers in electronic and electrical components, etc. Directors: P. M. Kovany (secretary) and S. J. Myers. Regd. office: 22, Queen Street, E.C.4.

Simmonds of High Wycombe, Ltd.—Registered 1st December. Capital £1,000. Manufacturers of and dealers in electrical goods, radio and television receivers and components, etc. Directors: N. Saltman and Deborah Saltman. Regd. office: 7 and 8, Queens Square, High Wycombe.

Abex Heating & Electrical Engineers, Ltd.—Registered 2nd December. Capital £100. Directors: L. S. Hall, C. B. Coley and B. S. Sinfield. Secretary: Valerie W. Hall. Regd. office: 59, Aylesbury Street, Bletchley.

A. J. Whetton, Ltd.—Registered 2nd December. Capital £6,000. Electrical engineers and contractors, etc. Solicitors: Lewis & Shaw, W.C.2.

John Berner, Ltd. — Registered 2nd December. Capital £100. Manufacturers of and dealers in all kinds of domestic appliances including washing machines, etc. Directors: J. M. Berner and Nancy Richardson. Secretary: J. Berner. Regd. office: 173, High Road, Ilford.

Carruth, Crowther & Caine, Ltd.—Registered 4th November. Capital £3,000. Electrical engineers and general electrical installation contractors, etc. Directors: J. Carruth, R. Crowther and L. Caine. Secretary: Alyce Caine. Regd. office: Tyersal Works, Tyersal Lane, Bradford.

Lyon Electric (St. Albans), Ltd.—Registered 3rd November. Capital £100. Manufacturers of and dealers in electrical appliances, radio, television, etc. Directors: R. H. Lyon and Beryl Lyon. Secretary: M. P. Smith. Regd. office: Fiscal House, 36, Lattimore Road, St. Albans.

Bankruptcies

J. W. McEvoy, sole proprietor of Domestic Electrics, 246, Easterly Road, Leeds.—First meeting held 16th December. Public examination 14th February at the County Court House, Albion Place, Leeds.

G. W. May, lately carrying on business at 2a, First Street, Chelsea, S.W.3, as an electrical contractor.—Order for discharge made 4th November, 1960, suspended for one year.

F. J. B. Pink, electrical and refrigeration engineer, lately carrying on business at Sherwood Works, Sherwood Road, Bognor Regis, Sussex, as Reliance Refrigeration Service Co. (described in the receiving order as Reliance Refrigeration Services).—Trustee, Mr. J. S. Bradley-Hole, 7, Old Steine, Brighton, appointed 6th December.

A. Middlemiss and **B. P. Howe,** lately carrying on business in partnership at 42b, Westgate Street, Ipswich, as Deben Home Appliances, and formerly carrying on business at 409, Spring Road, Ipswich, as Howe & Middlemiss, electrical retailers.—Trustee, Mr. R. A. Paterson, Archdeacon's House, Northgate Street, Ipswich, appointed 7th December.

D. E. Pitchers, formerly trading at 13, Tann Lane, Caister-on-Sea, Norfolk, radio and electrical engineer.—Supplemental dividend of 1s 6d in the £ payable at the Official Receiver's Office, Norfolk House, Exchange Street, Norwich.

L. A. James, carrying on business at 42, Clare Street, Bridgwater, Som., radio and electrical engineer, and trading as Domestic Electrics.—Receiving order made 8th December on debtor's petition.

C. Powell, trading as George Cooke & Co., Station Road, Wilmslow, Ches., electrical engineer.—Receiving order made 6th December on a creditor's petition.

T. K. Underwood, lately trading in partnership with others under the style of Fourways Electrical Services at 68, Carter Lane, Mansfield, Notts., and 18, Market Place, Shirebrook, Derbyshire, retailers of radio, television and electrical appliances.—Receiving order made 9th December on debtor's petition.

L. Smith, 134, Chase Side, Enfield, Middlesex, electrical retailer, trading as Smiths Electrics.—First meeting held 20th December. Public examination 21st February at the Court House, Fore Street, Upper Edmonton, N.18.

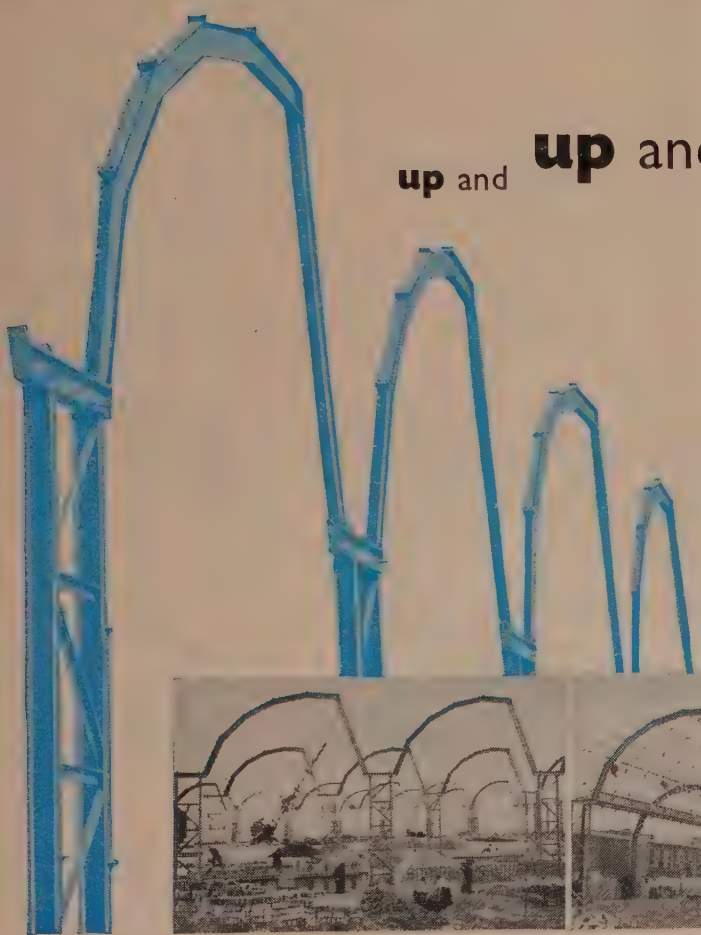
Liquidations

E.W.D. (Electrics), Ltd., electric washer distributors and dealers in electrical goods, 190, The Moor, Sheffield.—Liquidator, Mr. P. Cardwell, 93, Queen Street, Sheffield, appointed by members and creditors on 7th December.

Arthur C. Symons, Ltd., electrical contractors, 129, Sish Lane, Stevenage, Herts.—Winding up voluntarily. Liquidator, Mr. T. J. Woods, 39, Hermitage Road, Hitchin, Herts., appointed 25th November. Particulars of claims to the liquidator by 31st December.

Brendan Grove, Ltd., electrical contractors, 45, Hunter Road, Willesborough, Ashford, Kent.—Liquidator, Mr. J. L. Masters, 35, Bank Street, Ashford, Kent, appointed by creditors on 5th December.

Mead & Jeffery, Ltd., electrical engineers and contractors, 23, Lea Avenue, West Ealing, Middlesex.—Liquidator, Mr. R. A. Hawken, Bank Chambers, 1, John Street, Bedford Row, London, W.C.1 (with committee of inspection) appointed 23rd November.



up and up and up

go the sales of Silentbloc products. And up and up and up goes the new extension which will almost double our factory area. This will not only give us increased productive capacity to meet growing demand, but will add significantly to our already excellent facilities for research and development. We mean to lead the industry in the future as decisively as we have led it in the past. The new extension will begin production early in 1961.

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To fill the national press with arresting advertisements.

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To bring more business and more profits to all Osram dealers

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It all begins on January 9th, 1961!

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to all our friends
THE MICANITE & INSULATORS CO., LTD., LONDON, E.17.
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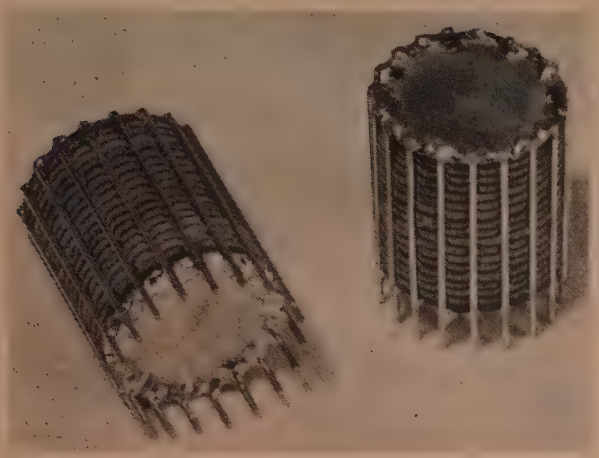


Fig. 1.—Proposed British circular component wafer, 0·45in in diameter

Author's summary of a lecture given on Wednesday before the Electronics and Communications Section of the Institution of Electrical Engineers

Micro-Miniaturisation

By L. J. WARD, B.Sc.Tech., A.M.I.E.E.*

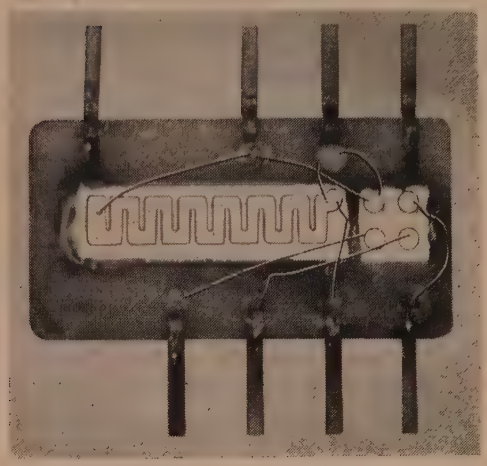


Fig. 3.—Silicon semiconductor solid circuit, $\frac{1}{4}$in by $\frac{1}{4}$in by $\frac{1}{10}$in

A CONSIDERABLE amount of effort is being expended in this country and in the U.S.A. on the development of micro-miniature electronic circuits. This interest in micro-miniaturisation arises from two causes; firstly, from the ever-increasing complexity of electronic devices, and secondly from the belief that the new techniques will lead to more reliable equipment. There are two basic forms of micro-miniaturisation: packaged circuits and integrated circuits. The packaged circuit is one that uses components of unified shape and size, including the active elements, stacked or packaged in a uniform manner and inter-connected. In this respect, conventional construction is packaged circuitry, except that the components are not standardised. The integrated circuits use various manufacturing processes to form the circuit elements and the interconnections *in situ*, on or in an insulating plate or semiconductor.

* English Electric Aviation, Ltd.

Fig. 2.—Flat plate circuit developed by the Royal Radar Establishment. (Crown Copyright)

Typical Examples

The R.C.A. micro-module programme sponsored by the United States Signal Corps is probably the best known and the most advanced programme on packaged circuits of its kind. The module is based upon a 0·3in by 0·3in ceramic component wafer 10 mils thick with three connecting notches per side. Circuits are built up by assembling these wafers on top of each other and interconnecting the notches. Components and modules are available to users.

A current British development in the early proposal stage is based upon a circular component wafer 0·45in in diameter with 19 interconnecting notches. While this may appear to be very similar to the R.C.A. design, there are a number of advantages; being circular there are now 19 possible angular positions of the wafer compared with four in the case of the square units. This additional flexibility allows the possibility of coding component connections, retaining the ability to build up many different circuits from standard components. The finished modules would be as shown in Fig. 1.

Two forms of integrated circuit appear in Figs. 2 and 3. Fig. 2 shows a flat plate circuit developed by the Royal Radar Establishment in which the resistors and condensers have been produced by evaporation techniques, and the transistors are inserted subsequently. Fig. 3 shows a semiconductor solid circuit produced by Texas Instruments.

The solid circuit takes advantage of current advances in solid state physics whereby the various circuit functions such as resistance and capacitance are produced in a semiconductor in addition to the transistors and diodes. Solid circuits are available today in small quantities, and flat circuits are being developed by one or two manufacturers.

Comparison of Techniques

Both techniques have their advantages and disadvantages and these very largely depend upon the type of application being considered. The packaged technique has the advantage of conventional component manufacture, in which high yield should be achieved with freedom to choose the best manufacturing process for each component. The technique is eminently suitable where development time must be short, and where enormous quantities are not required.

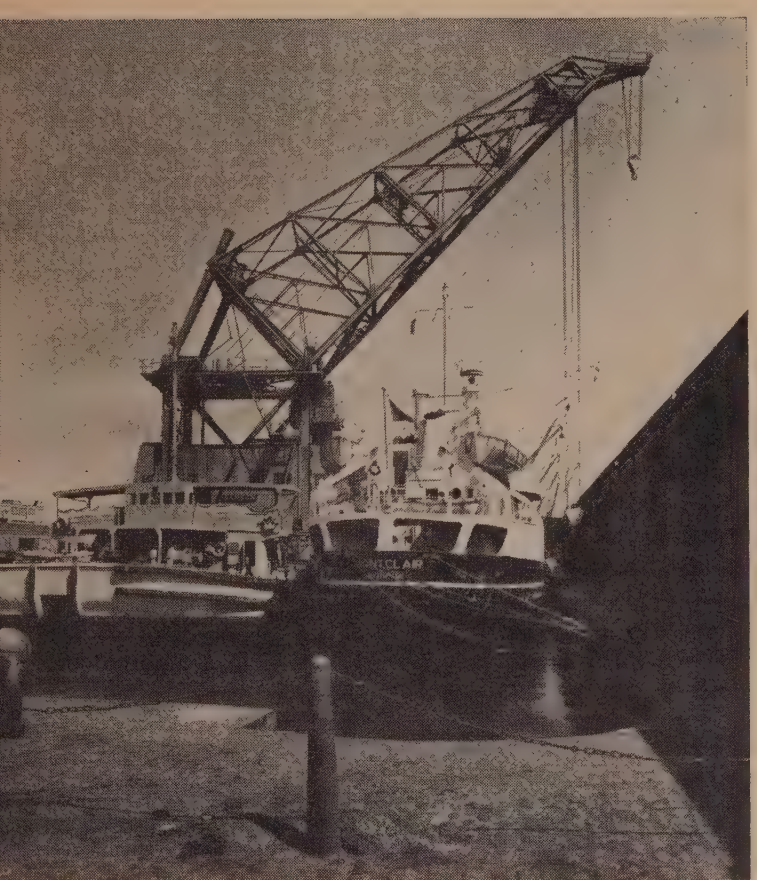
The integrated circuit would appear to have advantages where large quantities to a stable design are required. If difficulty is found in producing all the components in the truly integrated manner, bearing in mind the problems of yield and compatibility of manufacturing technique, then the system loses a number of its advantages.

We may see an attempt on the part of the component manufacturer to establish lines of standard circuits, based on either technique. The extent to which he will be able to meet the diverse requirements of the equipment manufacturer will depend on his flexibility and turn-round time. The equipment manufacturer will still require, however, a range of components to meet his more general requirements.

One would expect the reliability of the integrated circuits to be better than that of the packaged circuits, because of the absence of "manufactured" connections in the integrated circuits. However, if a large number of components have to be inserted and connected because of manufacturing difficulties, the reliability advantage will be considerably lessened. The reliability of the packaged circuits should be higher than that of those using current assembly methods since the joints can be systematically inspected and automatically manufactured.

FLOATING CRANE

Electrical Power and Propulsion Equipment



The 60-ton floating crane "Samson" for the Mersey Docks and Harbour Board

THE twin-screw floating crane *Samson*, built by Simons-Lobnitz, Ltd., and commissioned earlier this year by the Mersey Docks and Harbour Board, has been developed to meet the difficult conditions prevailing at Liverpool docks. The requirements included high manœuvrability owing to the confined areas in which it has to operate, and a higher speed than normal, 10½ knots, to cope with the fast tidal currents prevailing in the main channel. The main electrical power and propulsion equipment was manufactured by the General Electric Co., Ltd.

The main hoist of the crane has a capacity of 60 tons up to a maximum radius of 78ft 8in while that of the auxiliary hoist is 25 tons up to a maximum radius of 93ft 8in. Operating speeds of the hoists are 15ft/min and 55ft/min respectively. A power-driven travelling-ballast weight counterbalances the loads being lifted. Slewing through 360 degrees can be carried out in four minutes with a 60-ton load on the hook.

To assist in manœuvring the vessel in the confined waters of docks and alongside ships, a propelling device is fitted to the bows. Known as a bow-steering pump, it consists of an axial-flow type pump sited in a duct having outlets on the port and starboard sides of the craft. The pump, which is driven by a 200 h.p. electric motor, can expel water from either outlet, exerting a maximum thrust of approximately 2 tons. Additional manœuvrability is obtained from the widely-spaced twin screws and rudders.

Power Equipment

Each of the two 900 h.p. 600 r.p.m. Paxman 12 YLXZ diesel engines is connected through a "Twiflex" articulated flexible coupling to a main and an auxiliary generator.

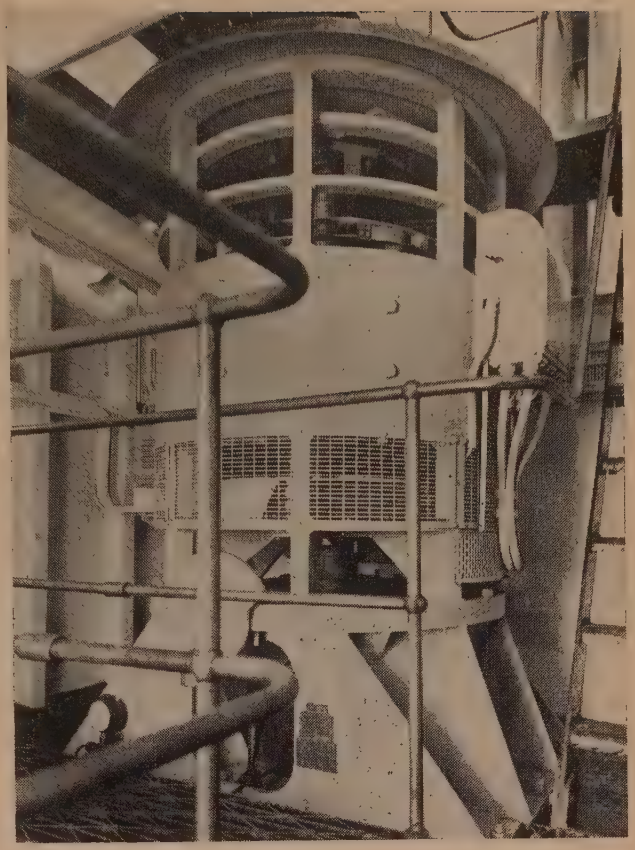
The rating of each main d.c. generator is 330 kW at 440 V and of each auxiliary d.c. generator 300 kW at 220 V. Power for the propulsion motors is obtained from the main generators, and for all other services from the auxiliary machines. The rating of the auxiliary generators is such that one machine is capable of supplying the entire crane and auxiliary service loads. A further two 30 kW 220 V d.c. generators, each driven by a Ruston 6YCZ diesel engine, provide power for the essential services when the 360 kW auxiliary generators are not running. Paralleling of all the 220 V generators is possible, thus preventing interruption when changing the source of supply.

Propulsion Motors

The screws are direct-coupled to 400 h.p. motors which are mechanically and electrically independent, separate Ward-Leonard speed control systems being employed for each motor. Four steps of speed in either direction are provided for each motor by variation of the appropriate generator field excitation. Relays automatically reduce this excitation if attempts are made to increase the load on the propulsion motors too rapidly. If conditions are such as to cause a sustained overload, then relays operate to remove the excitation completely.

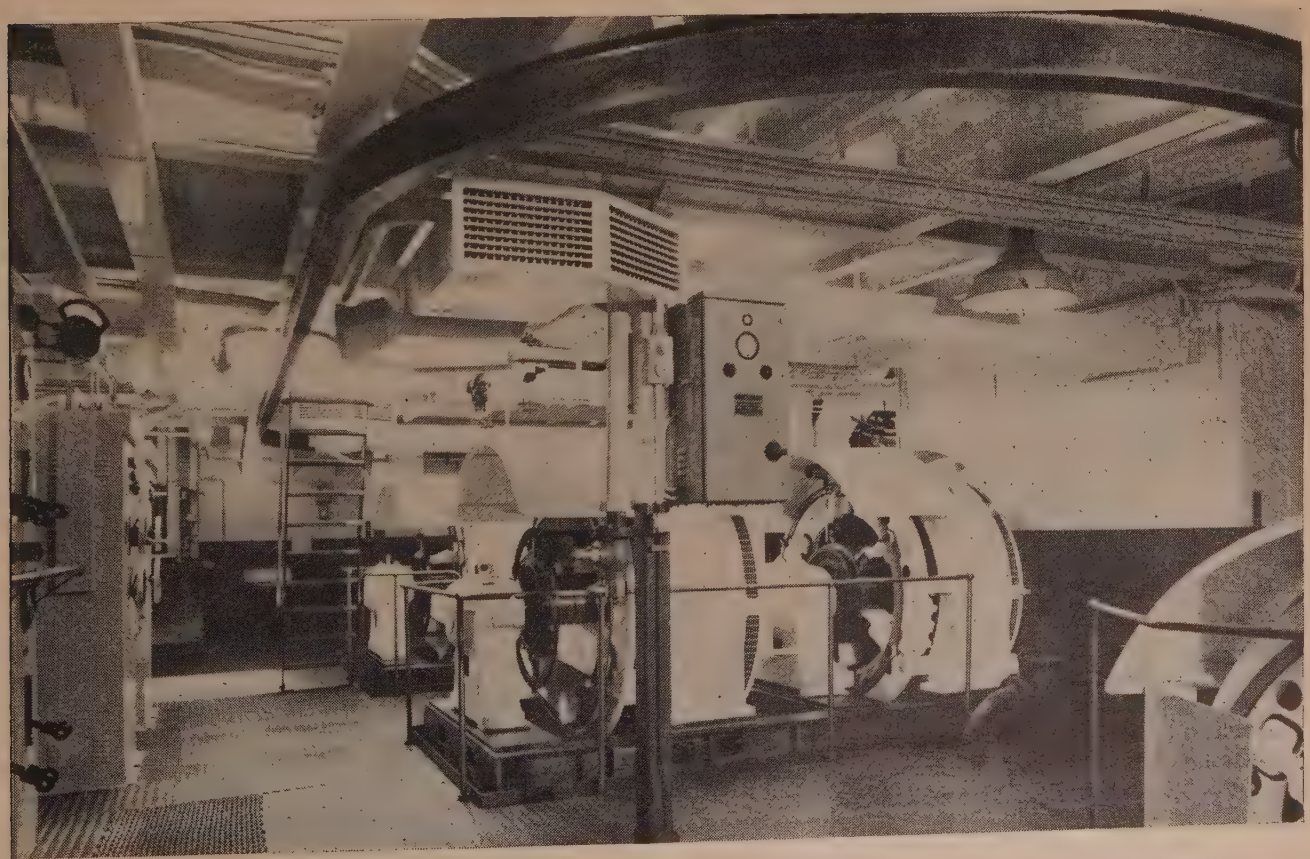
Control of motor speed is normally exercised from the bridge where there are three double telegraphs mechanically linked through clutches to the operating shafts of the control cubicles. The propulsion motors can also be operated from the engine room by hand-wheels mounted on the control panels. An alarm indication panel between the motor control cubicles is arranged to give warning should a fault occur on selected parts of the propulsion equipment.

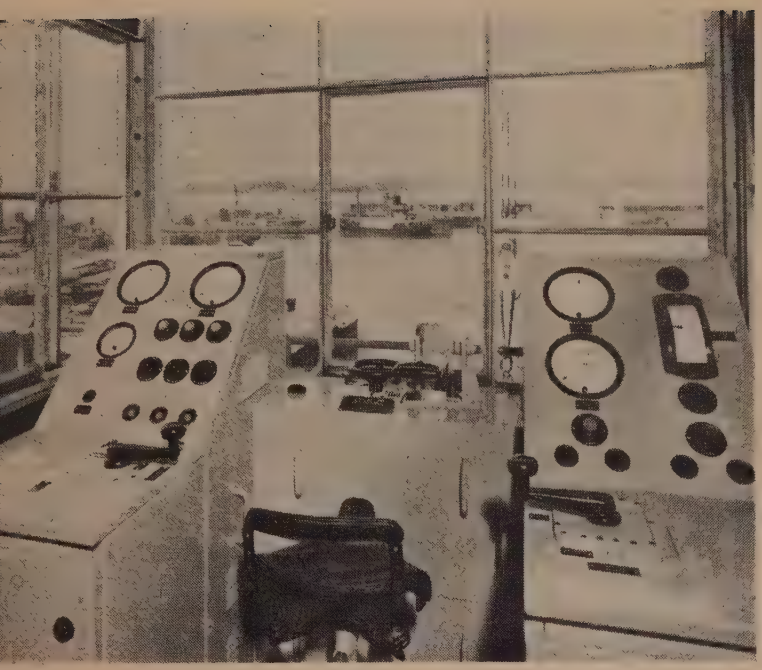
Power for the 130 h.p. crane hoists and the 75 h.p.



Bow-steering pump motor which assists in manœuvring the vessel in confined waters

G.E.C. port main propulsion and auxiliary generators. Mounted in a tandem arrangement, the generators are driven from a common diesel engine





Crane operator's control desk

derrick motor is obtained from a 107 kW Ward-Leonard set, which in turn is supplied from the 220 V auxiliary generator system. A three-position rotary-type selector switch enables a choice of either of the hoists or the derrick motor to be made, the speed of the particular motor selected being controlled by a nine-notch controller of the lever type. Speed control is effected by varying the separately-excited and self-excited fields of the Ward-Leonard generator, with the additional facility, in the case of the crane hoist motors, of field weakening on notch 9. The circuit is so arranged that in the event of an overload, or the tripping of a limit switch, the controller has to be returned to the first notch before the particular motor can be re-energised. When loads are being lowered, regenerative braking is employed, and if the auxiliary system is incapable of absorbing the regenerated power, ballast resistors are automatically introduced into the circuit to assist.

Series-wound slewing and ballast motors are employed, and these are supplied direct from the auxiliary generator system. The 45 h.p. slewing motor is energised through a six-notch controller and a contactor starter. This starter is fitted with a timing device to prevent the motor being accelerated too rapidly by the operator who nevertheless retains full control over the final speed of slewing. A divertor resistor on the first two notches permits creep-speed slewing.

Speed and direction of the 20 h.p. travelling-ballast motor are varied by a seven-notch controller, and a position indicator working on the potentiometer principle shows the location of the ballast trucks. Warning lights indicate if the forward or backward limit switches trip. Creep-speed operation is obtained by shunting the motor armature with divertor resistors.

All controls for the operator are housed in a cabin at the front of the crane superstructure. The structural and mechanical parts of the crane were manufactured by Cowans Sheldon & Co., Ltd., the main electrical machinery being supplied by the G.E.C. to the order of Charters of Glasgow.

CAMPAIGN TO SELL MORE TO LATIN AMERICA

THE Dollar Exports Council, which has been re-formed to include all the Latin American countries and renamed the Western Hemisphere Export Council, is launching a campaign to raise exports to Latin America.

This was announced by Lord Rootes, who has been chairman of the Dollar Exports Council since its formation in 1951 and will continue as chairman of the re-formed body. The electrical industry is represented on the Council by Sir John Woods, director, English Electric Co., Ltd., and Sir Bertram Waring, chairman, Joseph Lucas, Ltd.

Lord Rootes said at a press conference last week that "we have been marking time in many of these important Western Hemisphere markets, and this Council is pledged to do all it can to regain the forward thrust."

The U.K. currently accounts for some 6 per cent of the total imports of the Latin American countries, compared with 13 per cent before the war, and Germany's exports are now larger than those of Britain. Lord Rootes stressed the U.K.'s strong position as a buyer, since in the first three quarters of this year we sold goods worth £118 million to the Latin American countries but imported from them goods worth £242 million.

The new Council will encourage investment by British companies in the countries concerned as well as direct exports. Mr. Maudling, President of the Board of Trade, said that investments in new manufacturing facilities generally led to big increases in direct exports, but our investment overseas was already a good deal larger than our current surplus, and the outflow of capital had to be limited by our overseas earnings.

The United States is much the most important source of capital investment in Latin America. But there have also been large increases in recent years from Germany and France, both of which now have a greater stake in Latin America than the U.K. The value of Britain's investment is believed to be one-third the 1939 figure.

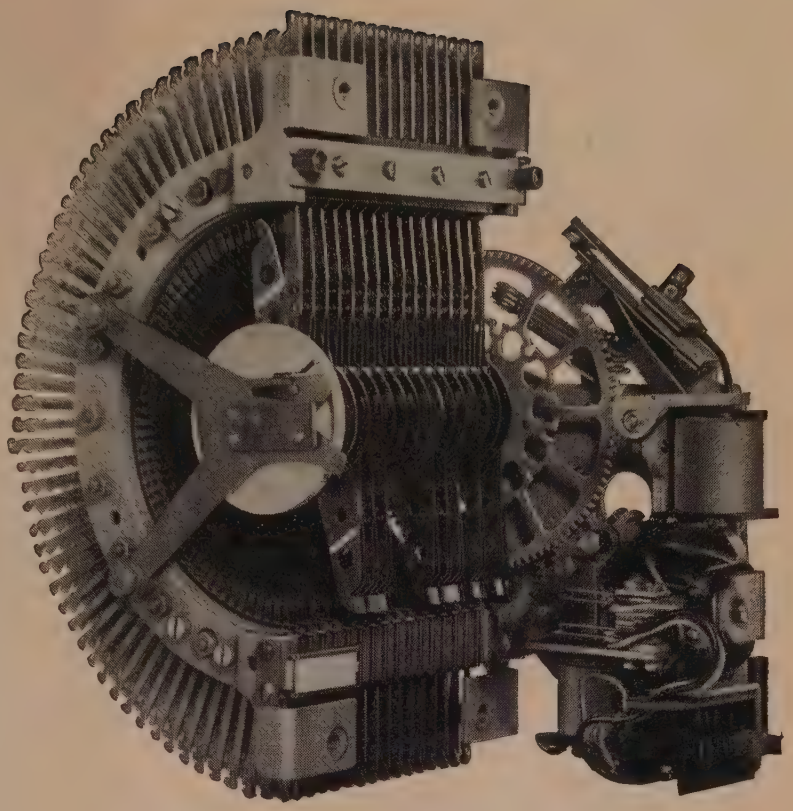
Mr. Maudling also said that after serious consideration it had been decided not to form a Commonwealth Export Council, because of the great differences in trading problems between Commonwealth countries.

B.R.A. LUNCHEON

The British Refrigeration Association is to hold its annual luncheon on 10th March at the Connaught Rooms, London. The Rt. Hon. F. J. Erroll, P.C., M.P., Minister of State, Board of Trade, has accepted an invitation to attend and it is anticipated that the chairman of the Association, Mr. C. M. Marks (managing director of Hussmann British Refrigeration, Ltd.), will preside.

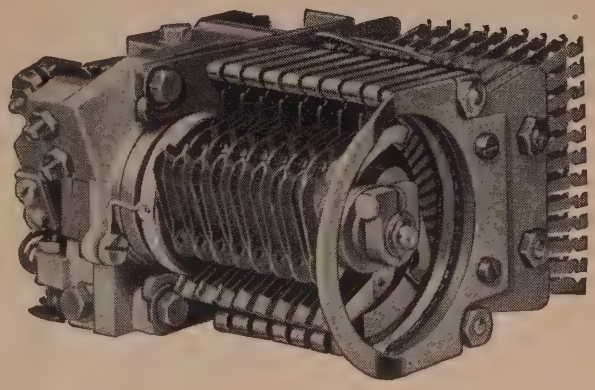
These 3 outstanding uniselectors

provide long life and reliability in operation



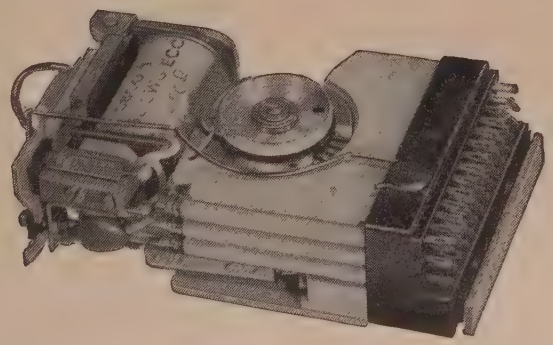
The high speed motor uniselector

has an availability of 52 outlets in a half revolution with up to 16 parallel channels, and is capable of high speed search if required. It is also suitable for scanning and other collection functions, or for the routing of information to a multitude of points. It can be brought to rest at any desired outlet by means of simple circuitry, and a homing drive is provided so that it can be readily restored to the normal position. Arrangements can also be made for step-by-step working.



The digit switch

is specifically designed for step-by-step operation in response to impulses, and has an availability of 12 outlets with 8 parallel channels. It may be used to set up a marking condition for the control of the Motor Uniselector.



The miniature uniselector

is a compact switch of unique design which occupies no more space than a standard 3000-type relay. It has an availability of 12 outlets with 3 parallel channels. A great advantage is that it incorporates a plug-in type of mounting so that the entire device can be removed and replaced without detaching any soldered connections.

AEI

Full technical information will gladly be supplied on application

ASSOCIATED ELECTRICAL INDUSTRIES LTD.

Telecommunications Division
Telephone Apparatus Department PD7
Woolwich, London, S.E.18
Woolwich 2020 Ext. 326

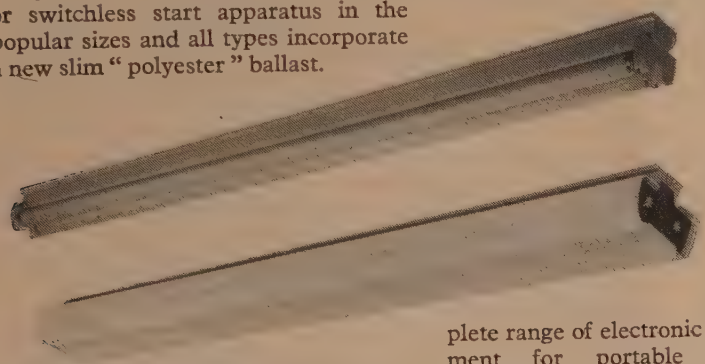
TA 2139

FD 7/2

NEW ELECTRICAL EQUIPMENT

Fluorescent Fittings

The "Streamlite" range of slim fluorescent lighting fittings introduced by PHILIPS ELECTRICAL, LTD., Century House, Shaftesbury Avenue, London, W.C.2, are intended primarily for commercial and industrial use and are not much greater in depth than the fluorescent tube itself. The fittings are available for one, two or three lamps in the 5ft 80 W size and for one or two lamps in the 2ft 20 W and 4ft 40 W sizes. They are obtainable with switch start or switchless start apparatus in the popular sizes and all types incorporate a new slim "polyester" ballast.



A twin-lamp basic mounting channel from the Philips "Streamlite" range. Below: A totally enclosed diffuser attachment is shown fitted to the twin-lamp channel

The fittings are suitable for single or continuous mounting and other features include sprung rotor lampholders; 10 A mains terminal block, and earth connection; full length backplate with cast alloy ends giving earth continuity for end entry conduit; variable fixing centres; and a range of diffusers and reflectors. Further details of the complete range, together with price lists, are obtainable from the manufacturers.

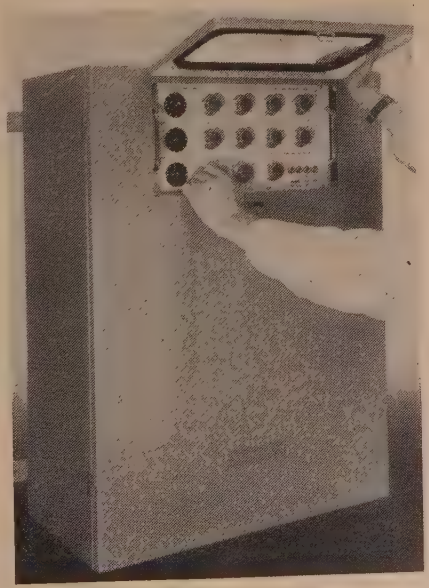
Solid Tantalum Capacitors

The solid tantalum electrolytic capacitors, known as type "tan-TI-cap," announced by TEXAS INSTRUMENTS, LTD., Dallas Road, Bedford, are available in 203 standard capacity-voltage combinations ranging from 1 to 330 μF $\pm$10 per cent and $\pm$20 per cent tolerance, and in standard voltage classes of 6, 10, 15, 20, 25 and 35 V d.c. They are built in four case sizes. Performance specifications give rated voltage operation at -55°C to $+85$°C and two-thirds rated voltage at 125°C with stable operation from -80°C to $+125$°C. The capacitors are of solid electrolyte, sintered tantalum anode construction which utilises a tantalum pentoxide dielectric film. Controlled deposition of the manganese dioxide semiconductor electrolyte plus the high-purity carbon and high-conductance negative counter electrode ensures high penetration, good electrical contact, and conformity with a maximum 6 per cent dissipation factor.

Gun-Welding Control

With the development of a compact synchronous resistance welding control equipment, designated Series CRW.4, LANCASHIRE DYNAMO ELECTRONIC PRODUCTS, LTD., Rugeley, Staffs., are now able to supply a complete range of electronic control equipment for portable gun-welding machines up to 1,200 kVA rating. The new Series CRW.4 equipment is a "packaged" control installation embodying fully synchronous timing throughout. Controlled timing of "squeeze," "weld," "hold" and "off" periods is provided, each interval being independently adjustable from 1 to 100 cycles in one-cycle steps, and

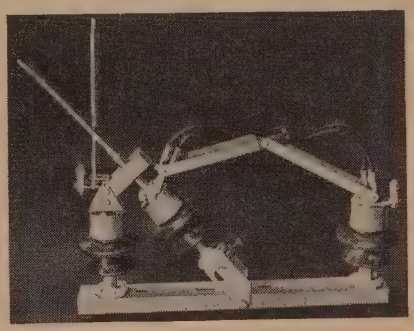
Lancashire Dynamo welding control panel



the equipment is suitable for single or repetitive spot operation. It has stepless power control with 30 : 1 range of weld heat without changing transformer taps and stepless adjustment of "up-slope" power during the weld period. The electronic contactor is designed to accommodate ignitrons of international sizes "A," "B" and "C." All supply systems from 220 to 500 V a.c. 50/60 c/s can be accommodated.

Medium Voltage Isolator

The airbreak isolators for rural installation announced by SWITCHGEAR & EQUIPMENT, LTD., Southam Road, Banbury, Oxon, are offered in two-insulator (type TLR2) and three-insulator (TLR3) forms, of 400 A normal current rating. The design has been tested to 13·1 kA for 3 sec throughput at 11 kV. There is a choice of four different insulators, and

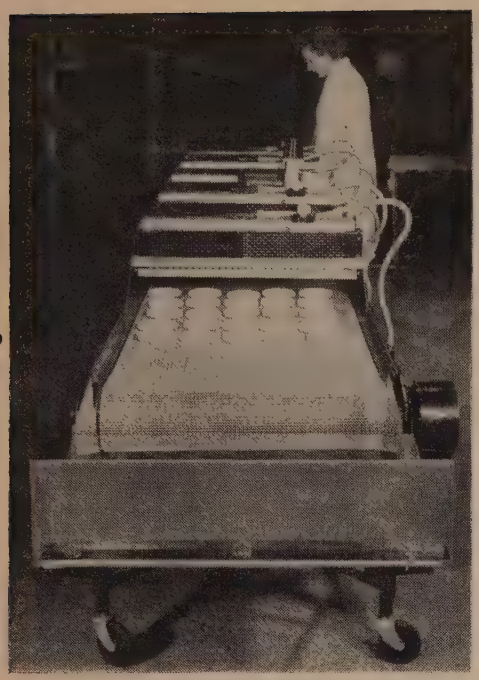


Switchgear & Equipment 11 kV isolator

these and the contact and arc-horn parts are readily replaceable. The fixed contact has U-shaped jaws which give increased pressure with increased current, while the moving contact is cylindrical and can be rotated to present new contact surfaces, thus prolonging its life. The universal supporting steelwork accepts either the two-insulator or the three-insulator isolator for vertical or horizontal mounting on single or H-post structures. Extensive use is made of British Standard pipe in the structure and the drive, and all drive connections are made by piercing-screw joints which obviate the necessity for specifying exact lengths of piping when ordering.

Infra-Red Drying Unit

A standard infra-red drying machine, the L/X5, is now available from GEORGE VOKES (INFRA RED), LTD., Infra Red Works, High Road, New Southgate, London, N.11. It is suitable for drying almost any flat or mainly flat article which has been coated or printed. Other models are available for shaped articles and for where a shorter conveyor run can be



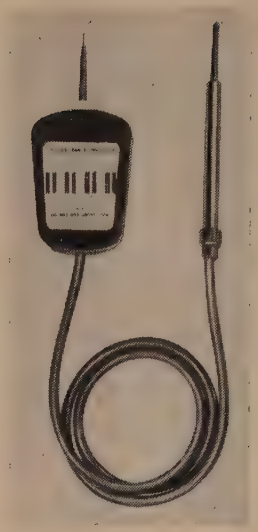
George Vokes infra-red dryer

used. Heat is supplied by five projector units, each containing three elements of "Inconel" metal tubing of oval shape. Articles to be dried are carried under these units on a 13ft conveyor, which feeds them into a hopper at the end of the machine. The conveyor speed can be adjusted to give a range of drying times from 15 sec to 4 min. The machine is available with five conveyor widths: 18in, 24in, 36in, 42in and 48in. In the first two widths the load is 10 kW; in the third, 15 kW; and 21 kW for the last pair, although this may be reduced when drying certain products.

The conveyor length is 13ft 3in. Temperatures available range from 60 to 400°C.

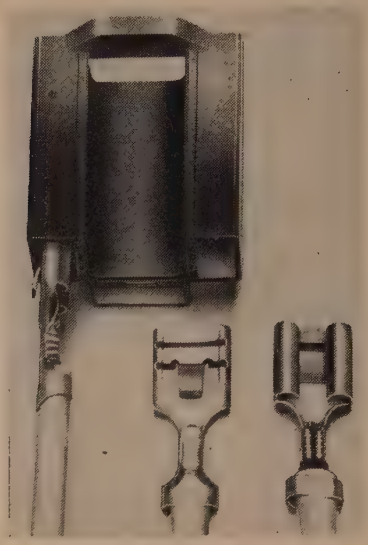
Voltage Range Indicator

An indicator which shows the voltage range to which it is connected has been developed by the MARTINDALE ELECTRIC CO., LTD., Westmorland Road, London, N.W.9. It can be used in the 50/600 V range on d.c. or a.c. of any frequencies up to and including those used in aircraft and missile control equipment. The indicator is made of moulded plastic and the dial contains four neon tubes which light progressively as the voltage rises. There is one retractable shrouded prod projecting from the case and a wander lead at the end of which is a probe with a retractable insulated sheath covering a metal prod. The probe holder contains a fuse and limiting resistor. The instrument measures approximately 3½ by 2½in and has no



Martindale voltage indicator

moving parts. All internal components are mounted on an insulated chassis.



A-MP headlamp connector

Sealed-Beam Headlamp Connector

A connector for sealed-beam headlamps is now being produced by AIRCRAFT-MARINE PRODUCTS (GREAT BRITAIN), LTD., Amplo House, 87-89, Saffron Hill, London, E.C.1. It consists of a moulding carrying three A-MP "Faston" terminals. The terminals are crimped to the appropriate colour-coded wiring of the vehicle and the terminals carrying the wiring are then pushed into the moulding, where they automatically snap into position. Incorrect polarity is impossible as the connector is irreversible.

P.C.M. TELEPHONE TRIALS

A new telephone transmission system using pulse-code-modulation (P.C.M.) is now undergoing extensive field trials on a working cable link in Madrid, Spain. This system has been developed by engineers of Standard Telecommunication Laboratories, Ltd. (S.T.L.), in conjunction with Standard Telephones & Cables, Ltd., and Le Matériel Telephonique of Paris. The system offers a tenfold increase in the number of telephone circuits possible over junction cables in towns and cities. In many cases it will also give improved, "clean" transmission, with a minimum of background noise.

For these tests, two Madrid telephone exchanges, Norte and Delicias, are linked by P.C.M. equipment over an existing 6 km length of cable. These facilities have been made available by the National Telephone Administration of Spain and the tests are being conducted with the co-operation of Standard Electrica, S.A. Madrid, an associate of S.T.L.

In the P.C.M. system, the speech from 23 subscribers is sampled in sequence 8,000 times per sec and these samples are applied to a common coding unit. The coder compares the instantaneous amplitude of each sample with a scale having 70 intervals, decides in which interval it lies, and generates the appropriate code character. Thus only a train of high-speed electrical pulses is sent.

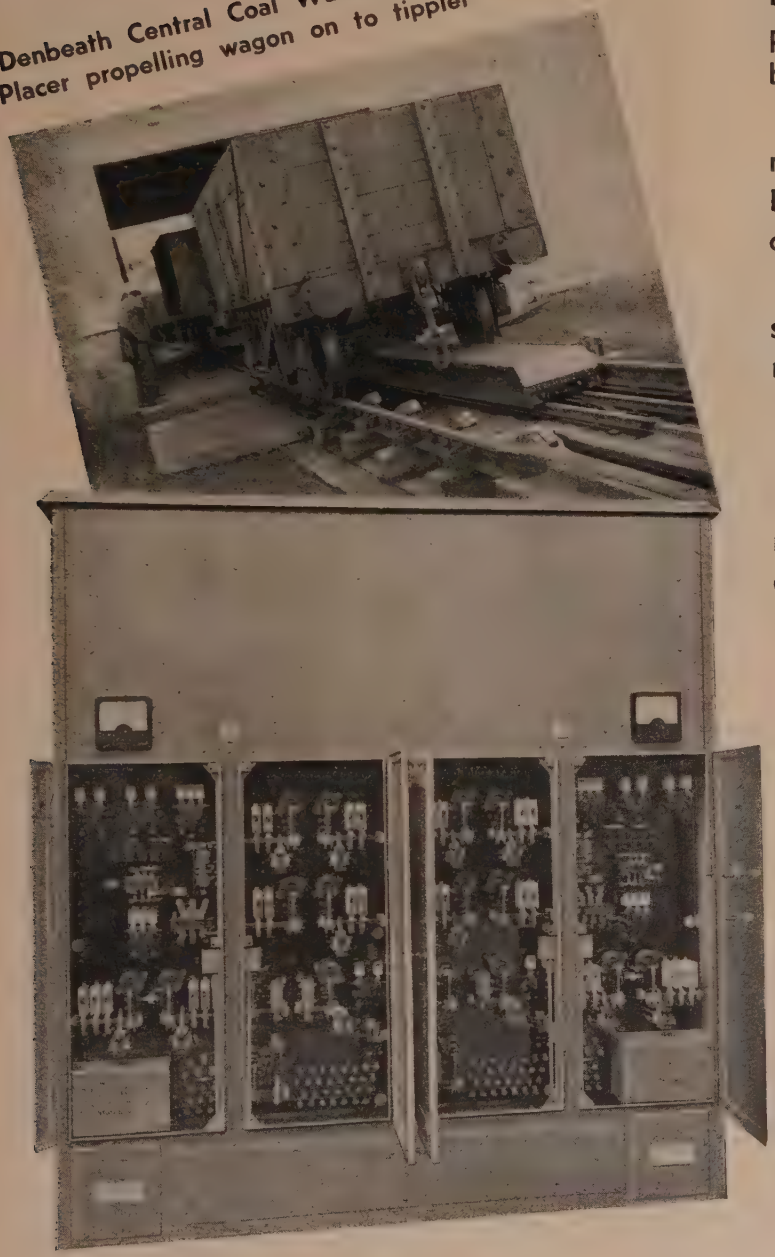
Due to the high frequencies involved, about 1·5 Mc/s, cable losses are quite high so that frequent repeatering is necessary. The repeaters are, however, very much simpler than those normally used in telephone circuits, since they act only as pulse regenerators. They use transistors and consume low power so that they are readily fed with power along the light gauge telephone cable itself.

At the receiver, the decoder turns these pulses back into pulses of varying amplitude which are then reconstituted into speech and distributed to 23 listeners. The reconstituted speech is not an exact replica of the original: it is an approximation, since the amplitudes of the samples are measured against a 70 level scale. On long or noisy routes, the overall quality is, however, better than with a direct voice frequency connection.

The transmission system operates on a four-wire basis (send and receive channels on separate pairs) and it is expected that it will be peculiarly compatible with time-division electronic exchanges.

——and another 'MICRO-sen'

Denbeath Central Coal Washery NCB
Placer propelling wagon on to tippler



THIS time in conjunction with E.M.B. Equipment it is used to control the haulage mechanism supplied by Mitchell Engineering Ltd., of Peterborough, for placing wagons on to the tippler at Denbeath Central Coal Washery N.C.B.

We understand that the whole equipment is working very satisfactorily and has become a showpiece for engineers from other areas.

The 'MICRO-sen' gives an accurate speed control for any standard A.C. slip-ring motor.

Speeds can be obtained ranging from 10% to full synchronous speed.

Other 'MICRO-sen' applications include nuclear power station cranes, skip hoists, coke oven plants, guided missile and rocket installations.

THE SIGN OF QUALITY
EMB
ESTABLISHED 1908

With acknowledgements to—
MITCHELL ENGINEERING LTD
THE DAYLITE ELECTRICAL Co LTD
THE NATIONAL COAL BOARD

E.M.B. Co Ltd

WEST BROMWICH
ENGLAND

ELLISON FUSE-SWITCHGEAR

Talking technically

It has been said that there are lies, damn lies and statistics. Nevertheless, in choosing switchgear one cannot afford to ignore certain technical data that distinguishes good reliable equipment from others.

For this reason we make no apologies for giving the following information concerning "Ellison" Heavy Duty Fuse-switchgear:

DESIGNED AND TESTED BY US TO B.S.3185:1959 for use with fuses tested to B.S.AC8:1952, Category AC5.

SWITCH MAKING CAPACITY—46,000 amps at 550 volts, ·15 P.F.

SWITCH BREAKING CAPACITY—3 times the rating at ·25/·3 P.F. at 550 volts.

BUSBAR AND CONNECTIONS—comply with B.S.159:1957.

FUSES—Any make of fuse to B.S.88:1952, Form B, can be fitted.

RATED CURRENTS	
FUSE-SWITCH	FUSED
AMP	AMP
100	2-200
200	2-400
300	2-400
400	350-500
600	350-600

Three-pole or three-pole and neutral link

May we send you further information?

TRADE MARK

GEORGE ELLISON
LIMITED

PERRY BARR · BIRMINGHAM 22B.

869

NEW PATENTS

Electrical Specifications Recently Published

The numbers under which the specifications will be printed and abridged are given in parentheses. Copies of any specification (3s 6d each including postage) are obtainable from the Patent Office, 25, Southampton Buildings, London, W.C.2

1952

7207. United Kingdom Atomic Energy Authority.—Separation of uranium and plutonium. 20th March, 1953. (855853.)

1955

33111. British Thomson-Houston Co., Ltd.—Thermo-nuclear reactors. 28th November, 1956. (855855.)

36213. Yardney International Corporation.—Alkaline electric cells. 13th December, 1956. (855653.)

1956

4996. English Electric Co., Ltd.—Hotplates for electric cookers. 15th February, 1957. (855654.)

5026. Metropolitan-Vickers Electrical Co., Ltd.—Nuclear reactors. 28th January, 1957. (855859.)

11836. English Electric Co., Ltd.—Electrical variable impedance device. 17th July, 1957. (855907.)

12835. Hayward Tyler & Co., Ltd.—Electric motors having rotors adapted to run in water or other liquid. 26th April, 1957. (855656.)

14660. British Nylon Spinners, Ltd.—Electrical measurement of the thickness of a thread. 17th June, 1957. (855595.)

15456. English Electric Co., Ltd.—High voltage resistors. 16th May, 1957. (855512.)

16868. Siemens Edison Swan, Ltd.—Contact springsets. 10th May, 1957. (855908.)

24141. Diamond H Switches, Ltd.—Control of radiant electric heating devices such as hot plates. 1st August, 1957. (855926.)

25304. Ferranti, Ltd.—Electrical frequency meters. 15th August, 1957. (855566.)

28164. British Thomson-Houston Co., Ltd.—Radio frequency apparatus for heating gases. 13th September, 1957. (855856.)

28945/6. British Thomson-Houston Co., Ltd.—Thermo-nuclear reactors. 17th September, 1957. (855857/8.)

29134. Metropolitan-Vickers Electrical Co., Ltd.—Thermo-nuclear reactors. 23rd December, 1957. (855868.)

38277. British Thomson-Houston Co., Ltd.—Amplifying circuit arrangements with feed-back. 14th December, 1956. (855911.)

38497. Siemens-Schuckertwerke A.G.—Rectifying apparatus having at least one semiconductor rectifier member. 17th December, 1956. (855725.)

1957

1373. Sperry Rand Corporation.—Composite magnetic core structures. 14th January, 1957. (855726.)

2151. Radio Heaters, Ltd.—Welding of plastic materials by dielectric heating. 15th April, 1958. (855659.)

5565. Gilbert & Barker Manufacturing Co.—Electronic level-sensitive device. 19th February, 1957. (855795.)

6591. Fernseh G.m.b.H.—Transistor circuits for generating control impulses. 27th February, 1957. (855602.)

7158. Magyar Adocsogyar.—Electric heating element. 4th March, 1957. (855798.)

8356. Precision Electronic Terminations, Ltd.—Fastener for coupling tubular elements. 13th March, 1957. (855603.)

9209. International Business Machines Corporation.—Electric impulse producing systems. 20th March, 1957. (855877.)

9966. Chilton Electric Products, Ltd.—Circuit-breakers. 10th June, 1958. (855730.)

11950. General Electric Co., Ltd.—Protective cans for nuclear reactor fuel elements. 10th April, 1958. (855661.)

14198 Soc. des Accumulateurs Fixes et de Traction.—Electric cells and batteries. 3rd May, 1957. (855812.)

15572. English Electric Co., Ltd.—Electrical resistor elements for switching resistors and the like. 16th May, 1957. (855513.)

16876. United States Atomic Energy Commission.—Push-pull tandem nuclear reactor using a liquid fuel. 28th May, 1957. (855671.)

17327. General Motors Corporation.—A.c. generators. 31st May, 1957. (855551.)

36029. Bendix Corporation.—Activation of ferroelectric materials. 19th November, 1957. (855567.)

38404. Air Reduction Co., Inc.—Electric arc welding control systems. 10th December, 1957. (855817.)

1958

2485. Automaton Telephones (London), Ltd.—Telephone answering apparatus. 24th April, 1959. (855833.)

4786. Compagnie Française Thomson-Houston.—Magnetron oscillator. 13th February, 1958. (855568.)

5800. Siemens & Halske A.G.—Circuit arrangements for the transmission of teleprinter messages through duplex transmission paths, for example in links between line and radio systems. 21st February, 1958. (855569.)

9219. Deutsche Edelstahlwerke A.G., Allgemeine Elektricitöte-G.m.b.H., and Stahl- und Walzwerke Rasselstein/Andernach A.G.—Method of progressively heating sheet metal, and an induction coil for performing the method. 21st March, 1958. (855847.)

9908 Marconi's Wireless Telegraph Co., Ltd.—Circuit arrangements for subtracting d.c. voltages. 26th January, 1959. (855685.)

13589. Electronics & Automation (London), Ltd., and Zemenides, A. D.—Arrangements for rechargeable electric batteries. 29th April, 1959. (855687.)

14739. Automatic Telephone & Electric Co., Ltd.—Electromagnetic relay arrangements. 28th April, 1959. (855779.)

15775. Munck, S. (trading as Munck Elektro-Mekanisk Industri, S.).—Electric motor for hoists or cranes. 16th May, 1958. (855691.)

16271. Tung-Sol Electric, Inc.—Thermo-responsive electrical switches. 21st May, 1958. (855675.)

16276. Armstrong Whitworth Aircraft, Ltd., Sir W. G.—Hermetically sealed plunger operared electric switch. 21st May, 1958. (855676.)

18087. Automatic Telephone & Electric Co., Ltd., and British Telecommunications Research, Ltd.—Transistor amplifiers. 22nd May, 1959. (855576.)

22989. Radio Heaters, Ltd.—Heating of foodstuffs. 13th July, 1959. (855558.)

23380. Maschinenfabrik Oerlikon.—Circuit arrangements for series wound motors. 21st July, 1958. (855604.)

24533. Westinghouse Brake & Signal Co., Ltd.—Rectifier circuit arrangements. 18th June, 1959. (855580.)

24603. Carr Fastener Co., Ltd.—Electrical plug connectors. 14th May, 1959. (855852.)

30780. Chamberlain & Hookham, Ltd.—Electricity meters. 21st September, 1959. (855830.)

31190. General Electric Co., Ltd.—Transistor amplifier circuits. 16th September, 1959. (855745.)

31215. Siemens-Schuckertwerke A.G.—Impulse current installations. 30th September, 1958. (855584.)

34688. Siemens & Halske A.G.—Transformers. 29th October, 1958. (855692.)

39506. Landis & Gyr A.G.—Electric flue-gas testers. 8th December, 1958. (855615.)

40017. Bendix Corporation.—Lighting arrangements for instruments. 11th December, 1958. (855616.)

41075. Bosch G.m.b.H., R.—Commutators for electrical machinery. 19th December, 1958. (855698.)

41309. Rohde, L., and Schwarz, H. (trading as Rohde & Schwarz).—Pulse controlled frequency dividers. 22nd December, 1958. (855631.)

1959

1427. Preco, Inc.—Vacuum cleaners. 14th January, 1959. (855744.)

3659. Telefunken G.m.b.H.—Frequency shift telegraph receivers. 2nd February, 1959. (855634.)

6718. Compagnie Industrielle des Telephones.—Device for adjusting the gain or attenuation of an electric wave. 26th February, 1959. (855638.)

7361. Siemens & Halske A.G.—Magnetic contact springs in gas-filled sealed glass tubes. 3rd March, 1959. (855890.)

8055. International Business Machines Corporation.—Sequence analysing circuit. 9th March, 1959. (855533.)

8966. Westinghouse Electric Corporation.—Oriented magnetic sheet. 16th March, 1959. (855750.)

9703. Western Electric Co., Inc.—Electromagnetic wave transmission systems. 20th March, 1959. (855723.)

13120. Allmänna Svenska Elektriska A.B.—Device for controlling a transductor or other electric amplifier. 17th April, 1959. (855639.)

13152. Stevens Manufacturing Co., Inc.—Thermostatic electrical switches. 17th April, 1959. (855782.)

16537. Western Electric Co., Inc.—Receiver apparatus for pulse communication systems. 14th May, 1959. (855758.)

NEXT WEEK'S EVENTS

Organisers of electrical functions are advised to make use of the "Electrical Review" clearing house, Room 221, Dorset House, Stamford Street, London, S.E.1, to ascertain that dates for their functions do not clash with others already arranged

FRIDAY, 30th DECEMBER

Coventry.—E.M.E.B. Sports and Social Club, Merrick Lodge, Sandy Lane, 7.30 p.m. A.S.E.E. Coventry and District Branch. "Development of Electrical Equipment for Machine Tools," by J. N. Leah.

London.—Wax Chandlers' Hall, Gresham Street, E.C.2, 12 noon. Commercial Travellers' Benevolent Institution. Annual Court of Governors.

Institution of Electrical Engineers, Savoy Place, W.C.2. Plastics Institute. "Plastics and Textiles," by Dr. H. A. Thomas.

John Adam Street, W.C.2, 2.30 p.m. Royal Society of Arts. Juvenile lecture, "The Legend of the Phoenix," by M. Burton.

Pepys House, 14, Rochester Row, Westminster, S.W.1, 7 p.m. Junior Institution of Engineers. Film evening.

SATURDAY, 31st DECEMBER

London.—Bucklersbury House, E.C.4, 8 p.m. I.E.E. London Graduate and Student Section. Dinner-dance.

The secretary of the I.E.E. Mersey and North Wales Centre informs us that the last meeting before Christmas was held on 12th December and not 16th December as published.

CONTRACT INFORMATION

Accepted Tenders and Prospective Electrical Work

CONTRACTS OPEN

Where "Contracts Open" are advertised in our "Official Notices" section the date of the issue is given in parentheses

Argentina.—Transportes de Buenos Aires. 28th February. 150 trams. (E.S.B. 32324/60.)*

Australia.—P.M.G.'s Department, Melbourne. 24th January. Transmitter parts. (E.S.B. 31998/60.)* 9th February. Diesel alternator sets. (E.S.B. 32482/60.)* 16th February. Electron tubes. (E.S.B. 32356/60.)*

Costa Rica.—Costa Rican Electrical Institute. 3rd January. Turbines, regulators and rotary valves for Dio Macho hydro-electric scheme. (E.S.B. 31999/60.)*

Durham.—County Council. Electrical installation in aged persons' hostel, Bishop Auckland. G. W. Gelson, county architect, South Street, Durham.

Formosa.—Central Trust of China, Taipei. 9th January. Electrical equipment. (E.S.B. 32313/60/I.C.A.)* 10th January. Distribution line material. (E.S.B. 32445/60/I.C.A.)* 16th January. Geared motor. (E.S.B. 32430/60/I.C.A.)*

Ghana.—Supply Commission, Accra. 23rd January. Cables. (See this issue.)

Hebburn (Co. Durham).—U.D.C. 10th January. Electrical installations in 42 houses, central area redevelopment scheme. R. C. Bestow, surveyor.

India.—Punjab State Electricity Board. 9th January. Electrical testing instruments. (E.S.B. 31908/60.)*

Heavy Electricals, Ltd. 27th February. X-ray unit, electronic detector, etc. (E.S.B. 31973/60.)*

Atomic Energy Establishment, Trombay. 31st January. 11 kV indoor metalclad switchgear units. (E.S.B. 32485/60.)*

Northern Ireland.—6th January. Electrical installation in Holy Cross Primary School, Kilkeel, Co. Down. C. P. McNally, consulting engineer, 143, Royal Avenue, Belfast.

Ormskirk.—West Lancashire R.D.C. 9th January. Sodium street lighting. (See this issue.)

Singapore.—City Council. 10th January. P.v.c. cables. (E.S.B. 32802/60.)*

Skipton.—U.D.C. 9th January. Rewiring of electrical installations. (See this issue.)

South Africa.—Durban Electricity Department. 13th January. Ring main switch and tee-off fuse switch units. (E.S.B. 31986/60.)* 20th January. Telephone cable. (E.S.B. 31984/60.)* Automatic circuit reclosers. (E.S.B. 31985/60.)*

Thailand. — Metropolitan Electricity Authority, Bangkok. 20th January. Copper cable. (E.S.B. 32486/60/D.L.F.)*

ORDERS PLACED

Barnsley.—Corporation. Recommended. Electrical installation work at St. Helens Secondary Modern School (£10,164).—N. G. Bailey & Co.

Hampshire.—Wessex Regional Hospital Board. Recommended. Electrical work: Alterations and additions to Lord Mayor Treloar Hospital, Alton (£2,325).—R. F. Webb. Firs Hospital, Bournemouth (£5,308).—E. W. Forster & Co. St. James Hospital, Portsmouth (£1,983).—G. E. Taylor (London).

Peterborough.—Electrical installations in 98 dwellings, Bluebell estate (£2,298).—M. F. Hansen.

WORK IN PROSPECT

Particulars of new works and building schemes for the use of electrical installation contractors and traders. Publication in this section is no guarantee that electrical work is definitely included. Alleged inaccuracies should be reported to the Editors

Aylesbury.—Houses (96), Oakfield; H. J. & A. Wright, Ltd., High Street, Great Missenden.

Ayr.—Factory, Heathfield Road; British Replin, Ltd., 20, Belvedere Road.

Houses (270), Braehead; burgh surveyor.

Basingstoke.—Factory, industrial estate; Wilkinson Sword, Ltd., Southfield Road, London, W.4.

Bedford.—School and training college on part of former Laxton nurseries; borough engineer.

Blandford.—Flats (40), Eagle House estate; H. W. Marsh, 16, East Street.

Boston.—Further 58 houses, 20 bungalows and a block of flats; borough surveyor.

Bury St. Edmunds.—County offices and library, Schoolhall Street; D. McMorran, architect, 14, North Audley Street, London, W.1.

Byfleet (Surrey).—Houses (275), Manor Farm site; A. J. Wait & Co., Ltd., Wellington Crescent, New Malden, Surrey.

Carlisle. — Supermarket, Botchergate; W. L. Tiffen & Sons, The Crescent.

Offices, Milbourne Street, for Border Engineering Contractors, Ltd., 125, Queen Street, Whitehaven.

Chatham.—Printing works, New Road Avenue; Farms & Partners, architects, 24, Welbeck Way, London, W.1.

Chelmsford.—Extensions, Essex Home School, Rainsford Road; Roff Marsh, architect, 125, New London Road.

Shops and offices, Moulsham Street; Kenneth Orin, Ltd., 20, Viaduct Road.

Chichester.—Crematorium, Westhampnett Road; city surveyor.

Coatbridge.—Hospital, Coatbridge/Airdrie area; Western Regional Hospital Board, 351, Sauchiehall Street, Glasgow.

Dunstable.—Shops, offices and flats, West Street; Gillham & Horsman, Ltd., Lennox Yard, Bletchley.

Durham.—Houses (20), Park Hill estate; F. Scollan, 3, Baldwin Avenue, East Boldon, Co. Durham.

Edgware.—Church and hall, Stone Grove; Riley & Glanfield, architects, 6, Raymond Buildings, Gray's Inn, London, W.C.1.

Epsom.—St. Clements R.C. church at Stoneleigh; Justyn Alleyn, architect, 1a, Berners Street, London, W.1.

Frimley and Camberley.—Shopping precinct in connection with development of Old Dean estate, Camberley; surveyor, Municipal Buildings, London Road, Camberley.

Girvan.—Houses, shops and offices in redevelopment area; burgh surveyor, Council Offices, Girvan, Ayrshire.

Grimsby.—Two blocks of flats (£32,091), Bath Street and Albion Street; borough engineer.

Guildford.—Extensions to Municipal Offices, Upper High Street; J. Mark & Partners, architects, 106, High Street, Guildford.

Works extensions; Vokes, Ltd., Normandy Works.

Hereford.—Grammar school, Fayre Oaks Cottages site, Kings Acre Lane (£250,000); county architect, Bath Road, Hereford.

High Wycombe.—Factory extension; C. Stevens & Sons, Ltd., Great Missenden.

Hitchin.—Houses (50), Offley; surveyor, 21, Bancroft.

Hove.—Flats (58), Hangleton Road; Greens Properties, Ltd., 2, Duke Street, Brighton.

Hull.—Works extensions; Reckitts, Ltd., Morley Street.

Ipswich.—Flats (215), Bramford Road area; borough engineer, 19, Tower Street.

Kidlington.—Fire service headquarters, fire station and workshops (£70,000); county architect, County Hall, Oxford.

Leeds.—Exhibition hall and car park on site of former tram depot, **Swinegate**; Modern Exhibition Services, Ltd., Burnley Road, Halifax.

London.—Office block, Gray's Inn Road, King's Cross; H. A. Halpern & Associates, architects, 7, Edgware Road, W.2.

Additional factory premises, Poplar; Associated Lead Manufacturers, Ltd., 308, West Ferry Road, E.14.

Six-storey offices, Caxton Street, Westminster; Ian Fraser & Associates, architects, 15, Bedford Street, W.C.2.

Margate.—Factory, Westwood estate; Cosgrove Wood Products, Ltd., Princes Street, Gravesend.

Middlesbrough.—Houses (79) and flats (16), Easterside estate; J. A. Kenyon, borough engineer.

Oban.—Houses (175), Corran Brae; burgh surveyor.

Rochester.—Dwellings (101), Earl estate; city surveyor.

Stockton-on-Tees. — Proposed grammar school (£130,000); P. R. Middleton & Partner, architects, 111, Albert Road, Middlesbrough.

Stoke-on-Trent.—College of Art; Hoare, Lea & Partners, consulting engineers, 23, St. James Road, Edgbaston, Birmingham.

Sunderland.—Shopping centre and junior and infants' school, Townend Farm estate; borough architect, Grange House, Stockton Road.

Sutton and Cheam.—Houses (36), Malden Road scheme, Cheam; C. Needham, borough engineer, High Street, Sutton, Surrey.

Taunton.—Factory estate, Priorswood; T. P. Penny, Ltd., Wood Street.

Tonbridge.—Houses (46), Bidborough, Brenchley, Capel, Lamberhurst and Paddock Wood; surveyor, 48, Pembury Road.

Uttoxeter.—Housing estate, Rocester and Mayfair area; Geo. Wimpey & Co., Ltd., Chester Road, Castle Bromwich.

Wallasey.—Tower block of flats, Mersey Street; borough architect.

Wendover.—R.C. church, Aylesbury Road; Archard & Partners, architects, 20, Lowndes Square, London, S.W.1.

Weston-super-Mare.—Factory in new development area; R. G. Lickfold, town clerk, Town Hall.

Wigton.—Houses (136) during 1961; R.D.C. surveyor.

Wrexham.—Houses (66), Montgomery Road and houses (14), Lorne Street/Park Street site; borough engineer, 31, Chester Street.

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* This information is extracted from the Board of Trade *Export Service Bulletin*. Inquiries should be addressed to the Board of Trade, Export Services Branch, Lacon House, Theobald's Road, London, W.C.2 (Telephone: Chancery 4411, Ext. 738), quoting the reference given.

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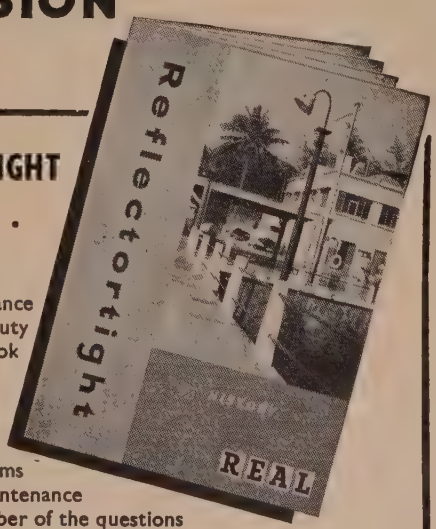

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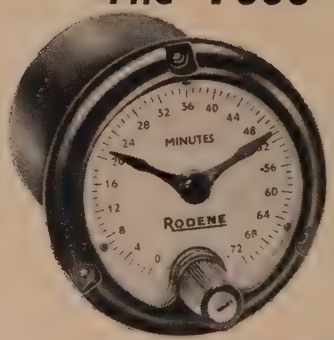

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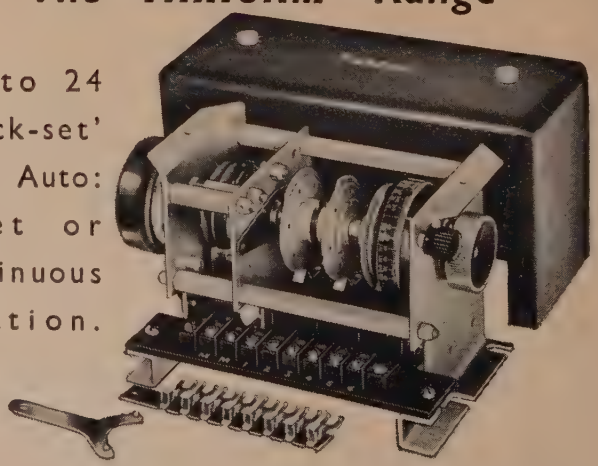

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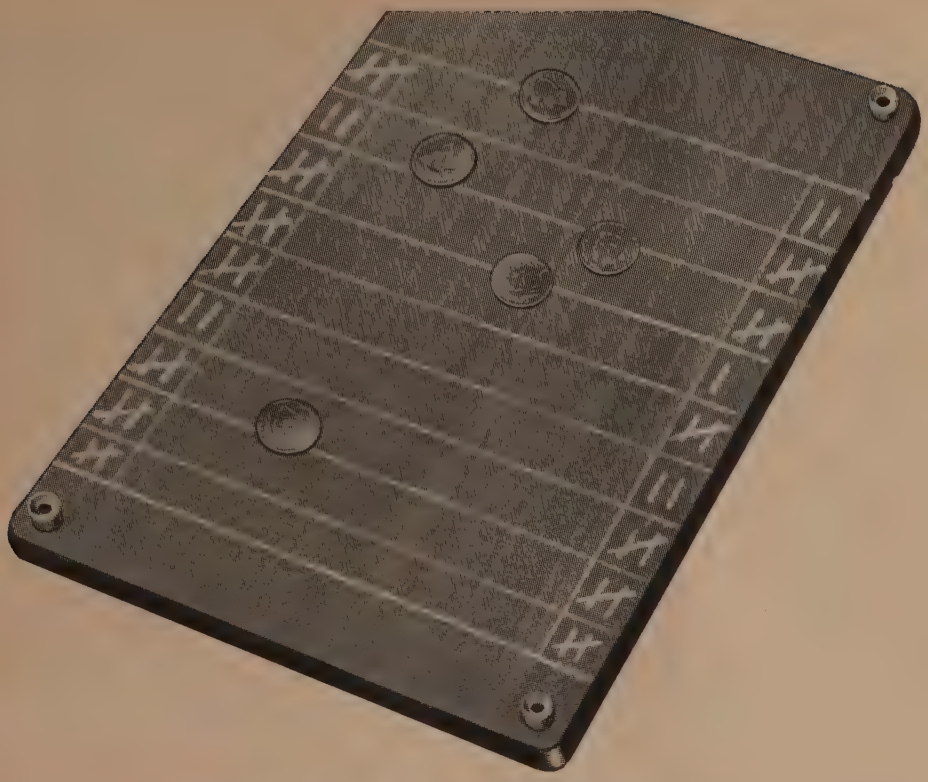

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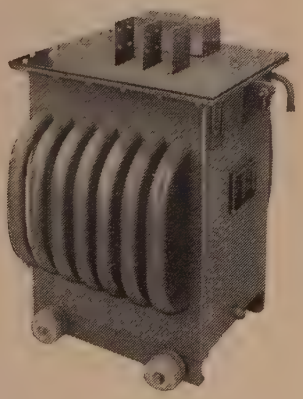

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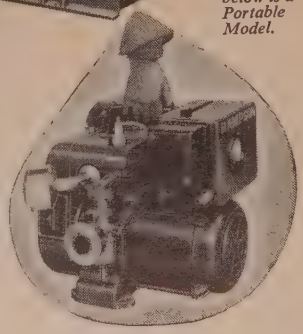

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Pylons down here will mean a better life up there. But how will the people of the valley feel about the pylons? And the people who visit the valley?

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■ These advertisements are appearing in the farming and country magazines. The Central Electricity Generating Board thank contractors for their co-operation in the past, and know that they will do all they can, while engaged on work for the Board, to preserve amenities.

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(Continued on page 56)

(Continued from page 55)

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Telephone: Calthorpe 2601-2

DYNAMO & MOTOR REPAIRS LTD.
Belgrave Terrace, Soho Road, Birmingham 21
Telephone: Northern 0898
Motor and generator repairs and rewinds. Installations and factory maintenance. Electrical plant stockists

ELECTRICAL INSTALLATIONS LTD.
Faraday Works, Stoney Stanton Road, Coventry
Telephone 21076-7-8
Industrial Electrical Work of All Kinds. Over 50 Years' Experience

FRANCE'S ELECTRICAL ENGINEERS LTD.
Darlaston, Staffs.
Telephone. JAMes Bridge 2822/3/4
Electrical Engineers and Contractors

Electrical Contractors
CABLE JOINTING & ERECTION CO.
Pavilion Buildings, Trent Bridge, Nottingham
Telephone : Nottingham 84887
Cable Jointing. Cable Laying. Keenest Prices.

For all types of Electrical Installations
W. J. FURSE & CO. LIMITED
Traffic Street, Nottingham
Telephone: 83471 (5 lines)
Electrical Engineering Contracting Specialists

Electrical Engineers and Consultants
W. H. TAYLOR (WOLVERHAMPTON) LTD.
Heantun House, Salop Street
WOLVERHAMPTON
Telephone 21687

SOUTH WALES

CLARKE BROS. (Stroud) LTD.
Green Park Street, Aberavon
Telephone: Port Talbot 2991
Electrical Engineers and Contractors
Rewinds and Repairs. Industrial Installations

DRAKE & GORHAM (Contractors) LTD.
13 St. Andrew's Crescent, Cardiff
Telephone: Cardiff 32080
Electrical Engineers and Contractors

. . . for all electrical installations
F. H. WHEELER & CO. LTD.
117 Woodville Road, Cardiff
Telephone 21281-2 — *Telegrams: "Whelect"*

CLARKE BROS. (Stroud) LTD.
High Street, Merthyr Tydfil
Telephone: Merthyr Tydfil 3377
Electrical Engineers and Contractors
Rewinds and Repairs. Industrial Installations

W. J. FURSE & CO. (MANCHESTER) LTD.
Royal Buildings, Talbot Road, Port Talbot
Telephone: Port Talbot 3276
For Electrical Installations and Contract Work

MERSEYSIDE & N. WALES

Electrical Engineers and Contractors for over 50 years
TROUGHTON & YOUNG LTD.
46 Rodney Street, Liverpool 1
Telephone: Royal 9231

HIGGINS & CATTLE LTD.
322 India Buildings, Water Street, Liverpool 2
Telephone: Liverpool Central 1729
Electrical Engineers and Contractors

Electrical Engineers and Contractors since 1919
SPEEDS (Widnes) LIMITED
2-4-6 Appleton Village, Widnes, Lancs.
Telephone: Widnes 2471-2-3

YORKSHIRE

Electrical Engineers and Contractors
SOUTHERN & REDFERN LTD.
Woodhead Road, Bradford 7
Textile Maintenance, Repairs and Rewinds
Telephones: Bradford 23871—Late Phone: Bradford 65837

(Continued on page 57)

(Continued from page 56)

Distribution, Control Gear, Instrumentation
STILLINGFLEET & HARPER LTD.
72/76 Commercial Street, Brighouse
Telephone: Brighouse 1930
All types of Industrial Installation

GREEN & SMITH LTD.
Albert Works, Meadow Lane, Leeds 11
Telephone 20834-5-6
Industrial and Commercial Installations. Motor Sales and Repairs. Electrical Floor Heating and Air Conditioning, etc.

. . . for all electrical installations
F. H. WHEELER & CO. LTD.
44 Bank Street, Sheffield 1
Telephone 24015 (3 lines) *Telegrams: "Whelect"*

NORTH WESTERN

STEWART THOMSON & SONS (Liverpool) LTD.
Fort Road, Seaforth, Liverpool 21
Repairs and Rewinds A.C. and D.C. to 3,000 horsepower. Breakdowns. Urgent Repairs, etc. 24-hour service
Telephone: Bootle 2697-8

DRAKE & GORHAM (Contractors) LTD.
21 Newton Street, Piccadilly, Manchester 1
Telephone: Manchester Central 4701
Electrical Engineers and Contractors

. . . for all electrical installations
F. H. WHEELER & CO. LTD.
Regal Buildings, Oxford Road, Manchester 1
Telephone: Central 8207-8

Industrial Installations
W. H. SMITH & CO. ELECTRICAL ENGINEERS LTD.

Contracting	Manufacturing	Electronic Maintenance
12 York Street, Manchester 2	Shepley Estate, Audenshaw	Grosvenor Street, Manchester
CENtral 2991-8	*DENton 3961*	*ARDwick 5011*

W. J. FURSE & CO. (MANCHESTER) LTD.
20 Mount Street, Manchester 2
Telephone: Blackfriars 5014-5-6
For Electrical Installations and Contract Work

JAMES SCOTT & CO. (ELECTRICAL ENGINEERS) LTD.
Bermuda House, 4/6 Hall Street, Manchester 2
Telephone: Manchester Central 3571
Britain's largest Electrical Installation Organisation for all high-class Electrical Installation and Instrumentation

Electrical Engineers and Contractors since 1919
SPEEDS (Widnes) LIMITED
2-4-6 Appleton Village, Widnes, Lancs.
Telephone: Widnes 2471-2-3

NORTH EASTERN

COX-WALKERS LTD.
North Eastern Electric Works, Feethams, Darlington
Electrical Contractors of repute since 1880. Motor Rewinds and Manufacturing Engineers
Telephone: 66277/8

Engineers and Contractors
CITY ELECTRICAL CO.
Turks Head Yard, Cecil Street, Lincoln
Telephone: Lincoln 124 *London: HOLborn 9722*

NORTH OF ENGLAND ENGINEERING & ELECTRICAL CO. LTD.

Ferryhill	86 Ryhope Rd.	Palladium Buildings
Co. Durham	Sunderland	Middlesbrough
Tel : 435/6	*Tel : 58762*	*Tel : 88156*

ELECTRICAL INSTALLATION CONTRACTORS

JAMES SCOTT & CO. (ELECTRICAL ENGINEERS) LTD.
Argyle House, Argyle Street, Newcastle-upon-Tyne 1
Telephone 28605
Britain's Largest Electrical Installation Organisation for all high-class Electrical Installation and Instrumentation

. . . for all electrical installations
F. H. WHEELER & CO. LTD.
52 Elswick Road, Newcastle
Telephone: Newcastle 36271

SOUTH WEST SCOTLAND

JAMES SCOTT & CO. (ELECTRICAL ENGINEERS) LTD.

80/110 Finnieston Street	21/25 George IV Bridge
Glasgow, C.3	Edinburgh
Telephone: Central 3866	*Telephone: Central 6424*

Britain's Largest Electrical Installation Organisation for all high-class Electrical Installation and Instrumentation.

REPUBLIC OF IRELAND

Electrical Engineering Contractors
A. G. BRUTY LIMITED
38 Dawson Street, Dublin
Telephone: Dublin 73181

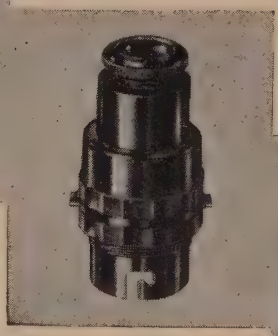
Applications for particulars of costs and standard style of advertisements in this Regional Guide should be addressed to:
THE
ADVERTISEMENT DEPARTMENT,
ELECTRICAL REVIEW,
DORSET HOUSE, STAMFORD STREET, LONDON, S.E.1

Volex

A completely new range of LAMPHOLDERS

TO THE *NEW* SUPPLEMENT No. I. (1959) B.S.S. 52—1952

Screwed Entry V/2



T.R.S. Gland V/3

Angle Batten V/7

Backplate with Terminal V/19
Batten V/6

H.O. Shield V/HO

Ensures the interchangeability of shade carrier rings and Home Office shields.

Tolerances of screw threads provide for variations of dimensional changes during the life of the lampholder.

Shade ring threads 18 T.P.I.

Spring or Solid plungers

VOLEX ELECTRICAL PRODUCTS LTD.

Telephone: PENDLETON 4373 SALFORD 6 Telegrams: VOLEXPROD, Salford 6

Classified Advertisements

CLASSIFIED advertisements are PREPAID at 3/6 per line (approx. 6 words).

DISPLAYED CLASSIFIED:—48/- per single column inch.

Where an advertisement includes a Box Number there is an additional charge of 1/-.

SERIES DISCOUNTS for consecutive insertions:—13, 5%; 26, 10%; 52, 15%.

SITUATIONS WANTED:—Three insertions under this heading can be obtained for the price of two if ordered and prepaid with the first insertion.

Cheques and Postal Orders should be crossed and made payable to ILIFFE ELECTRICAL PUBLICATIONS LTD.

REPLIES TO BOX NUMBERS should be addressed to the Box Number in the advertisement, c/o ELECTRICAL REVIEW, Dorset House, Stamford Street, London, S.E.1. If an applicant for a situation appearing under a Box Number does not wish his reply to be forwarded to a particular firm or individual, instructions to this effect should be addressed to the Advertisement Supervisor, ELECTRICAL REVIEW. The name of an advertiser using a Box Number cannot be disclosed.

OFFICIAL NOTICES, TENDERS, ETC.

WEST LANCASHIRE RURAL DISTRICT COUNCIL

Street Lighting

THE Council invite tenders for the supply, erection and commissioning of 55 Class "A" positions using 140-w. Sodium Discharge units mounted on concrete columns and 527 Class "B" positions using M.F. lamps mounted on concrete columns; to be erected in the various parishes of the Rural District.

Tenders may be submitted for any or all of the following three sections:—

(a) Supply of Concrete Columns and Brackets.
(b) Supply of Transformers, Capacitors, Discharge Lamps and Lanterns.
(c) Erection of Columns and Brackets, fitting and wiring of electrical equipment, fuses and all requisites not supplied in (a) or (b), removal of redundant equipment and putting the completed installation into commission.

Specification, bills of quantities, schedule of positions and form of tender may be obtained from the Engineer and Surveyor, West Lancashire Rural District Council Offices, Derby Street, Ormskirk, on payment of a deposit of £2 2s., which will be refunded on receipt of a bona fide tender not subsequently withdrawn. Plans may be inspected at the above Council Offices.

Sealed tenders in plain envelopes marked "Street Lighting" must be delivered to the undersigned not later than 12 noon on 9th January, 1961.

WM. RIGBY,
Clerk of the Council.

Council Offices,
52, Derby Street,
Ormskirk, Lancashire. 7108

BOROUGH OF DROITWICH

Street Lighting: District Roads

TENDERS are invited from experienced contractors for the supply, delivery and erection of 52 Street Lamps in District Roads, together with wiring, lanterns and auxiliary gear.

Conditions of contract and plan may be inspected at, and specification, bills of quantities and form of tender obtained from the Borough Engineer and Surveyor, Town Hall, Droitwich, during normal office hours upon payment of a deposit of £2 2s., which sum will be returned on receipt of a bona fide tender and the return of all documents.

Tenders, in plain sealed envelopes, endorsed "Street Lighting, District Roads," to be delivered to the undersigned not later than 10 a.m. on Monday, 2nd January, 1961.

The Council do not bind themselves to accept the lowest or any tender.

S. G. FOSTER,
Town Clerk.

Town Hall,
Droitwich, Worcs.
6th December, 1960. 7038

COUNTY BOROUGH OF BLACKPOOL

Purchase of Electric Lamps, 1961/62

TENDERS invited for the supply and delivery of the Corporation's Electric Lamp requirements for the year ending 31st March, 1962.

Specification, form of tender, etc. (returnable by 2.30 p.m., 6th January, 1961) from Director of Lighting and Electrical Services, Rigby Road East, Blackpool. 7095

GHANA SUPPLY COMMISSION

Tenders for Supply of Electric Cables

THE GHANA SUPPLY COMMISSION invites manufacturers to submit tenders for the following:—

Tender Ref. Elec./4023/1:
61,000 yards Low-voltage Underground Cable, various sizes.

Tender Ref. Elec./4024/1:
29,000 yards High-voltage Underground Cable, various sizes.

Forms of tender and conditions of contract are obtainable as from 15th December, 1960, on payment of a fee of £G.1, from the Secretary, Ghana Supply Commission, P.O. Box M.35, Accra, Ghana.

The closing date for the receipt of tenders will be 23rd January, 1961. 7092

SKIPTON URBAN DISTRICT COUNCIL

Re-wiring of Electrical Installations

TENDERS invited for re-wiring electrical installations at 83 pre-war Council Houses, Shortbank Road.

Contract documents from Engineer and Surveyor, Town Hall, Skipton, on deposit of £2 2s. (refunded on receipt of bona fide tender).

Tenders, in envelope provided, bearing no indication of sender, to be in by 9th January, 1961.

The Council do not bind themselves to accept the lowest or any tender.

L. E. SMITH,
Clerk to the Council.

7118

SITUATIONS VACANT

(See "Replies to Box Numbers" above)

UNIVERSITY OF ST. ANDREWS

APPLICATIONS are invited for a SENIOR LECTURESHIP or a LECTURESHIP in ELECTRICAL ENGINEERING in the Department of Electrical Engineering, Queen's College, Dundee, to commence not later than 1st October, 1961. It is intended to appoint the most suitable candidate irrespective of his particular interest.

Salary scales: Senior Lectureship, £1,925 × £75 to £2,425; Lectureship, £1,050 × £50 to £1,400 × £75 to £1,850 (efficiency bar £1,400). F.S.S.U.; family allowance; grant towards furniture removal expenses.

Applications (6 copies), containing the names of three referees, to the undernoted, from whom further particulars may be obtained, not later than 21st January, 1961.

PATRICK CUMMING,
Joint Clerk to the University Court.

Queen's College,
Dundee. 7111

ELECTRICAL ENGINEER

required by North-West Kent firm to take charge of laboratory under chief electrical designer.

Applicants should hold a Higher National Certificate and have some experience of the manufacture of rotary electrical equipment.

Please write giving full particulars to Box 7117.

CHRISTMAS

ADVERTISEMENTS for the issue of 30th December have now closed for press

Advertisements are accepted up to first post on **Monday** of the week of issue

If blocks, bold type or ruled borders are required then on **Friday** prior to week of issue

All communications to be addressed to:
Classified Advertisement Department,
ELECTRICAL REVIEW
Dorset House, Stamford Street
London, S.E.1

Original testimonials should not be sent with applications for employment

ELECTROLYTIC ZINC COMPANY OF AUSTRALASIA LIMITED

Risdon Works, Hobart, Tasmania

Electrical Engineering Assistants

COMMENCING SALARY RANGE at the rate of £A.1,425 - £A.1,650 per annum (depending upon qualifications and experience), giving ESTIMATED TOTAL REMUNERATION, £A.1,650-£A.1,900 per annum (including bonus at 1959 value).

The bonus mentioned above is paid half-yearly and is based upon the dividend rate declared by the company.

QUALIFICATIONS. Recent graduates or diplomates in electrical engineering or in engineering having majored in power electrical engineering, those who expect to so qualify at the end of the present academic year or who hold equivalent qualifications.

PLANT. Risdon Works is a large electrochemical plant.

Total employees approximately 2,850 (electrical engineering department 350).

Average power demand, 85 mW (114,000 h.p.).

Installed electrical equipment includes rotary converters (46 mW), mercury-arc rectifiers (21 mW), germanium rectifiers (15 mW), twelve 11-kV/415-v. substations, with H.V. and L.V. distribution systems, some 2,500 motors and a variety of other industrial equipment.

Electrical engineering department is responsible for all electrical design, construction, operation and maintenance.

Projected work includes replacement of rotary converters with rectifiers, extension of substation and distribution systems and continuing installation of new plant.

HOUSING. A house or flat could be made available to a married man.

APPLICATIONS to be addressed to the General Superintendent, Electrolytic Zinc Co. of Australasia Ltd., Box 377-D, G.P.O., Hobart, Tasmania.

Copies of references and details as to country of origin, age, marital status, educational qualifications, experience (if any) and date on which duties could be commenced are to be provided. Further information will be supplied on request. 244

SOUTH OF SCOTLAND ELECTRICITY BOARD

Stirling Area

DEMONSTRATORS (Vacancy No. 85/60) required for Bathgate, Falkirk and Stirling Districts.

Applicants should possess a recognised diploma or certificate for domestic science and be capable of giving public lectures and demonstrations, advising consumers on the use of electrical apparatus, and affording general assistance in the Board's service centres.

N.J.C. conditions. Salary Grade I, £600/£700 per annum. The posts are superannuable.

Applications, on the standard form obtainable from Area Manager, S.S.E.B., Woodlands, St. Ninians Road, Stirling, should be submitted not later than 30th December, 1960. 7109

Situations Vacant (continued)

MIDLANDS ELECTRICITY BOARD

APPLICATIONS are invited for the following superannuable posts :—

North Staffs. Sub-Area

SECOND ASSISTANT
(Commercial Engineering Dept.)
(Newcastle-under-Lyme).

The successful applicant will be required for sales promotion duties, and should have a sound commercial experience, including a thorough knowledge of modern sales methods and techniques, and should be capable of organising sales campaigns and sales promotion activities designed to develop the sale of electrical appliances. Duties will include the supervision of service centres, demonstrators and sales representatives. Appropriate qualifications desirable. Salary £965/£1,090 per annum (N.J.B. Grade F.8).

Apply by letter, within 14 days, stating age, qualifications, experience, present position and salary to Mr. C. C. Pimble, Sub-Area Manager, Midlands Electricity Board, 234, Victoria Road, Fenton, Stoke-on-Trent.

Shropshire and Herefordshire Sub-Area

THIRD ASSISTANT DISTRICT ENGINEER (Shrewsbury).

Applicants should have had experience in the construction and maintenance of high and medium-voltage distribution systems. Technical qualifications desirable. Salary £825/£940 per annum (N.J.B. Grade E.9).

Apply by letter, within 14 days, stating age, qualifications, experience, present position and salary to Mr. W. Winwood, Sub-Area Manager, Midlands Electricity Board, Spring Gardens, Ditherington, Shrewsbury.

South Staffs. and North Worcs. Sub-Area

SECOND ASSISTANT DISTRICT COMMERCIAL ENGINEER
(Stourbridge).

Applicants should have had a sound technical training with wide practical experience in the sale and installation of domestic and commercial electrical equipment and the work associated therewith. The successful applicant will be required to assist in all branches of commercial work, including advising consumers on domestic, commercial and industrial equipment, estimating and contracting work. Technical qualifications desirable. Salary £965/£1,090 per annum (N.J.B. Grade F.8).

Apply by letter, within 14 days, stating age, qualifications, experience, present position and salary to Mr. H. A. P. Caddell, Sub-Area Manager (Ref. EMI/SEC), Midlands Electricity Board, P.O. Box No. 9, Toll End Road, Tipton, Staffs.

Wolverhampton and District Sub-Area

GENERAL ASSISTANT DISTRICT COMMERCIAL ENGINEER
(Wolverhampton).

Applicants should have had a sound technical training and experience in all branches of commercial work. Technical qualifications desirable. Salary within the ranges £715/£805, £765/£870 or £825/£940 per annum (N.J.B. Grades J.15, J.14 or J.13), according to qualifications and experience.

Apply by letter, within 14 days, stating age, qualifications, experience, present position and salary to Mr. D. Holt, Sub-Area Manager, Midlands Electricity Board, 83, Darlington Street, Wolverhampton.

F. W. CATER,
Secretary. 7121

TRINIDAD AND TOBAGO ELECTRICITY COMMISSION

WEST INDIAN ENGINEERS who are interested in careers with the Trinidad and Tobago Electricity Commission are invited to write to the Secretary, P.O. Box 121, Port-of-Spain, Trinidad, West Indies. There are good opportunities for young West Indian Nationals with Degrees in Electrical Engineering or who hold Higher National Certificates in Electrical Engineering or who are Graduate Members of the Institution of Electrical Engineers. Commencing salary £1,050 per annum. Experience not necessary but candidates MUST be qualified. 6922

M.K. ELECTRIC LIMITED

have the following vacancies in their Technical Drawing Office:—

DESIGNERS—experienced in the design of small Electrical/mechanical products for large quantity manufacture.

DRAUGHTSMEN—with routine Drawing Office experience and preferably in connection with small electrical products — preparing standard drawings, data sheets, etc.

Excellent working conditions in a new drawing office. Five-day week of 37½ hours. Holiday arrangements honoured and attractive salaries offered according to experience.

Applications treated in strict confidence if addressed to:—

Technical Manager, M.K. ELECTRIC LTD.
Shrubbery Road, Edmonton, London, N.9

7094

BRITISH RAILWAYS

EASTERN REGION ELECTRIFIED LINES
LONDON AREA

ASSISTANT CONTROL ROOM OPERATORS

required under Railway Electrical Conditions to assist in the operation of the Electrical Control Room at Romford. Applicants should have served a recognised apprenticeship and possess knowledge of E.H.T. and L.T. Distribution systems, Isolation Procedure and Safety Precautions.

Shift working involved. Rate of pay £12.2.0 per week of 44 hours plus Shift Allowance 33/-. Enhanced pay for overtime and Sunday duty. Applicants required to undergo Medical examination. Certain free and reduced rate rail travel facilities. Pension and Sick Pay Schemes. Prospects of promotion.

Apply in writing giving age, apprenticeship and experience to the Electric Traction Engineer (London Area), British Railways, Eastern Region, off Ley Street, Ilford, Essex. 7045

ATOMIC ENERGY RESEARCH ESTABLISHMENT, HARWELL
requires
ELECTRICAL TECHNICIANS

for development, testing and construction work on EITHER

(a) High-voltage low-inductance capacitor banks with multiple spark gap switching OR

(b) Experimental devices to connect to these banks involving work on H.V. insulation, cable terminations, strong magnetic fields, vacuum equipment and measuring devices.

SALARY £1,015-£1,160 p.a.

Applicants should have served a recognised engineering apprenticeship or have had equivalent training, and have experience of experimental work with voltages above 25 kV, including D.C. and impulse equipment. National Certificate in Electrical Engineering would be an advantage.

Housing and superannuation schemes.

Send POSTCARD for details to Personnel Manager (1822/48), U.K.A.E.A., A.E.R.E., Harwell, Didcot, Berks. 7102

CHELTENHAM AND GLOUCESTER JOINT WATER BOARD

Appointment of Electrician at Mythe Waterworks, Tewkesbury

APPLICATIONS are invited from suitably qualified and experienced persons for the above appointment. Preference will be given to candidates having experience of the maintenance of large horse-power electric motors and associated equipment.

The N.J.I.C. rates will apply for Engineering Craftsman, which are £11 6s. 7½d. for a normal 5-day week of 42 hours. (Rate of pay 5s. 4¾d. per hour). Normal overtime rates will apply. In addition, a rent and rates free house is available.

The successful applicant will be required to join the Board's superannuation scheme.

Applications to be submitted to the undersigned not later than noon on Monday, 2nd January, 1961.

W. E. C. BIRD,
J. H. GOODRIDGE,
Joint Engineers.

P.O. Box No. 12,
Municipal Offices,
Cheltenham. 7110

SOUTH EASTERN ELECTRICITY BOARD

ASSISTANT DISTRICT ENGINEER, Croydon and Purley District.

Salary £1,165-£1,295 per annum, including London allowance under N.J.B. Agreement, Class J, Grade 9, superannuable.

Applicants should be suitably qualified and have operational experience of maintenance and construction on distribution system up to 11 kV. Candidates should also have experience of planning work.

Applications, quoting ER, and naming two referees, on forms from District Manager, SEEBOARD, Electric House, Wellesley Road, Croydon, by 4th January, 1961.

ASSISTANT DISTRICT ENGINEER, Croydon and Purley District.

Salary £1,325-£1,460 per annum, including London allowance under N.J.B. Agreement, Class J, Grade 7, superannuable.

Applicants should be suitably qualified and have responsible experience of maintenance on distribution system equipment up to 11 kV. Candidates should also have experience of construction and planning work up to the same voltage.

Applications, quoting ER, and naming two referees, on forms from District Manager, SEEBOARD, Electric House, Wellesley Road, Croydon, by 4th January, 1961.

ASSISTANT DISTRICT ENGINEER, West Kent District.

Salary £875 to £990, including London allowance under N.J.B. Agreement, Class G, Grade 11. Superannuable.

Applicants should have technical qualifications up to H.N.C. standard, with training and experience in the construction, operation and maintenance of underground and overhead distribution systems up to 11 kV.

Applications, quoting ER, and naming two referees, on forms from District Manager, SEEBOARD, 286, High Street, Orpington, Kent, by 4th January, 1961.

ASSISTANT DISTRICT ENGINEER, Sevenoaks and Reigate District.

Salary £1,115 to £1,245 per annum under N.J.B. Agreement, Class G, Grade 7. Superannuable.

Applicants should be suitably qualified and have responsible experience of maintenance on distribution system equipment up to 11 kV.

Candidates should also have experience of construction and planning work up to the same voltage.

Applications, quoting ER, and naming two referees, on forms from District Manager, Sevenoaks and Reigate District, SEEBOARD, Electric House, West Hill, Oxted, Surrey, by 4th January, 1961.

ASSISTANT DISTRICT ENGINEER, Central Sussex District.

Salary £890 to £1,015 per annum under N.J.B. Class F, Grade 9. Superannuable.

Applicants should be suitably qualified and have had training and experience in the construction, operation and maintenance of underground and overhead distribution systems. The successful candidate may elect to have a service tenancy of a Board flat.

Applications, quoting ER, and naming two referees, on forms from District Manager, SEEBOARD, Electra House, Church Road, Haywards Heath, Sussex, by 4th January, 1961.

GEORGE WRAY,
Secretary. 7101

WELSH COLLEGE OF ADVANCED TECHNOLOGY
Cathays Park, Cardiff

Electrical Engineering Department

APPLICATIONS are invited for the posts of (i) a SENIOR LECTURER, (ii) a LECTURER, in Electrical Engineering, duties to commence on 1st May, 1961.

Salary :—

Senior Lecturer, £1,550 × £50 to £1,750 per annum.

Lecturer, £1,370 × £35 to £1,550 p.a.

Applicants should possess a University Degree together with teaching and industrial experience.

Application forms (together with further particulars) may be obtained from the Registrar at this College, to whom they should be returned by 14th January, 1961.

ROBERT E. PRESSWOOD,
Clerk to the Governors.
7113

BAHAMAS ELECTRICITY CORPORATION

Applications are invited for the position of

DISTRIBUTION CONSTRUCTION ENGINEER

with the Bahamas Electricity Corporation in Nassau. Applicants must be Graduate Members of the Institution of Electrical Engineers and have had experience in both underground and overhead construction work on an electricity supply distribution system.

The contract will be for a period of three years with a possibility of renewal or permanent appointment.

Salary will be £1,760 per annum.

Official housing is not available but a rent allowance will be paid equal to £65 per month less 15% of the officer's monthly salary.

Tourist class return air passages will be provided for the officer and his wife and family up to a maximum of three adult fares.

Upon satisfactory completion of the contract the person engaged will be entitled to 28 days' full pay leave for each year of service and in addition a gratuity equal to 10% of his annual salary for each year of completed service.

Two weeks' local leave may be granted annually at the discretion of the General Manager.

There is at present no income tax in the Bahamas.

The successful applicant will be provided with official transport but will be required to undertake standby duty on a rota with other members of the distribution staff.

Applications should be sent in the first instance to the General Manager, Bahamas Electricity Corporation, c/o General Post Office, Nassau, Bahamas, and the envelope endorsed "Distribution Construction Engineer."

Closing date for applications will be 9th January, 1961.

7107

CENTRAL ELECTRICITY GENERATING BOARD

London Division

APPLICATIONS are invited for the following superannuable posts. Salary includes London allowance.

CHEMICAL ASSISTANT, ACTON LANE POWER STATION
(Vacancy No. 60/1006).

Candidates should have as minimum G.C.E. in English, Maths., Physics and Chemistry. Day release, in approved cases, up to age 21 for further study. Duties include work in a laboratory and on power station plant. Salary rising to £855 per annum.

CHEMICAL ASSISTANT, FULHAM POWER STATION
(Vacancy No. 60/1007).

Candidates should have as minimum G.C.E. in English, Maths., Physics and Chemistry. Day release, in approved cases, up to age 21 for further study. Duties include work in a laboratory and on power station plant. Salary rising to £855 per annum.

Applications, quoting vacancy number, may be made on the standard form obtainable locally and sent to the Personnel Officer, Central Electricity Generating Board, London Division, P.O. Box 136, Generation House, Great Portland Street, London, W.1, to be received not later than 3rd January, 1961. 7112

AIR MINISTRY

STATION ENGINEERS (G.D.) and STATION ENGINEERS (Mech.) required at R.A.F. and Ministry of Aviation stations throughout the United Kingdom. The work of Station Engineers (G.D.) consists of installation, operation and maintenance of high and medium-voltage electrical distribution systems, electrical power and lighting installations, control systems and generating plant; knowledge of heating and ventilating plant and diesel engines an advantage. Station Engineers (Mech.) are concerned with diesel power plant, steam and hot water heating systems, refrigeration and air conditioning and miscellaneous workshop plant, tools and equipment.

Candidates should hold O.N.C. Elec. or Mech./C. and G. Electrical Technicians Certificates/2nd Class M.O.T. Certificate or equivalent, and must also have had recognised apprenticeship with firm of good repute plus 3 years' employment in electrical or mechanical and engineering, preferably on operation and maintenance of mine, factory or workshops plant and services. Preference to candidates with supervisory experience.

Commencing salary, which is dependent upon age, qualifications and experience, ranges from £745 (age 25) to £925 max. in Grade III. There are pension prospects and also opportunities of advancement to numerous posts in the higher grades vacancies which, as a rule, are filled by promotion of Grade III staff, viz.:—

Technical Grade II ..... (276 posts)	£925-£1,055
Inspector of Works Grade 1 (137 posts)	£1,055-£1,295
Technical Grade B ..... (25 posts)	£1,295-£1,491
Technical Grade A ..... (17 posts)	£1,385-£1,630

Overseas tours for which special allowances ranging at present up to £1,800 p.a. are payable in addition to a higher salary. Internal training courses are provided and financial assistance and time off is allowed for recognised courses of study leading to higher qualifications. 5-day week with 18 days' paid leave a year initially.

Applicants, who must be natural-born British subjects, up to age 55, should write stating age, qualifications and experience to the Manager (P.E.1), Ministry of Labour, Professional and Executive Register, Atlantic House, Farringdon Street, London, E.C.4. No original testimonials should be sent. Candidates selected will normally be interviewed in London and certain expenses reimbursed. Only applicants selected for interview will be advised. 249

CITY OF LIVERPOOL EDUCATION COMMITTEE

College of Technology
Byrom Street, Liverpool, 3

Principal: S. A. J. Parsons, B.Sc.(Econ.), M.I.Mech.E., M.I.Prod.E., M.B.I.M.

Department of Navigation

APPLICATIONS are invited for the appointment of ASSISTANT, GRADE "B" (full-time).

Salary £700 × £27 10s. to £1,150 per annum.

Additional graduate and training allowances, where applicable, will be paid and the commencing salary will be assessed according to previous industrial, professional and teaching experience.

Applicants should hold the Ministry of Transport Extra Master's Certificate, and the possession of a Radar Maintenance Certificate would be an added qualification. Good sea experience of radar is desirable.

Application form (returnable by 6.1.61) and further particulars from H. S. Magnay, M.A., Director of Education, 14, Sir Thomas Street, Liverpool, 1.

THOMAS ALKER,
Town Clerk and Clerk to the Local Education Authority.
7096

(J.6566)

CLASSIFIED ADVERTISEMENTS ARE PREPAID

Situations Vacant (continued)

CENTRAL ELECTRICITY GENERATING BOARD

East Midlands Division

GENERAL ASSISTANT ENGINEER (Chemist), NORTH WILFORD POWER STATION (Vacancy No. 273/60).

Applications are invited for the position of General Assistant Engineer (Chemist) at North Wilford Power Station, Queens Drive, Nottingham.

Candidates must have had a sound technical training and previous laboratory experience and should preferably hold the Higher National Certificate in Chemistry, but consideration will be given to candidates studying for that qualification.

The salary will be within the range £625-£805 per annum of the National Joint Board Agreement.

Closing date for receipt of applications, 30th December, 1960.

GENERAL ASSISTANT ENGINEER (Chemist) (Male or Female), WILLINGTON POWER STATION (Vacancy No. 274/60).

Applications are invited for the position of General Assistant Engineer (Chemist) (Male or Female) at Willington Power Station, P.O. Box 27, Derby.

Candidates must have had a sound technical training and previous laboratory experience and should preferably hold the Higher National Certificate in Chemistry, but consideration will be given to candidates studying for that qualification.

The salary will be within the range £625-£805 per annum of the National Joint Board Agreement.

Closing date for receipt of applications, 30th December, 1960.

STATION SHIFT CONTROL ENGINEER, DERBY POWER STATION (Vacancy No. 275/60).

Applications are invited for the position of Station Shift Control Engineer at Derby Power Station, Full Street, Derby.

Applicants should have had a sound technical training and practical experience in a modern power station. The possession of a Higher National Certificate in Electrical Engineering, or its equivalent, would be an advantage.

Salary will be in accordance with Class F, Grade 10 (£825 - £940 per annum) of the National Joint Board Agreement, plus shift allowance.

Closing date for receipt of applications, 30th December, 1960.

PLANT SHIFT CONTROL ENGINEERS, WILLINGTON "A" POWER STATION (Vacancy No. 277/60).

Applications are invited for the positions of Plant Shift Control Engineers at Willington "A" Power Station, P.O. Box 27, Derby.

Applicants should have had a sound technical training and experience of the operation of a power station, including electrical control room experience. Preference will be given to candidates who possess technical qualifications to Higher National Standard, and experience of pulverised fuel firing will be an advantage.

Salary will be in accordance with Class L, Grade 10 (£1,190-£1,325 per annum) of the National Joint Board Agreement, plus 10 per cent allowance for shift duties.

Closing date for receipt of applications, 6th January, 1961.

GENERAL ASSISTANT ENGINEER (Chemist), HIGH MARNHAM POWER STATION (Vacancy No. 278/60).

Applications are invited for the position of General Assistant Engineer (Chemist) at High Marnham Power Station, Newark, Notts.

Candidates should possess the Ordinary National Certificate in Chemistry as a minimum qualification, and should have previous experience in the analysis and testing of coal, water and oil, preferably in a power station laboratory.

The salary will be within the range £625-£805 per annum of the National Joint Board Agreement.

Closing date for receipt of applications, 6th January, 1961.

ASSISTANT SHIFT CHARGE ENGINEER, HIGH MARNHAM POWER STATION (Vacancy No. 279/60).

Applications are invited for the position of Assistant Shift Charge Engineer at High Marnham Power Station, Newark, Notts.

Applications are invited for the position of Assistant Shift Charge Engineer at High Marnham Power Station, Newark, Notts.

Applicants should have had a sound technical training and practical experience in a modern power station. Preference will be given to candidates with qualifications leading to Corporate Membership of the Institution of Electrical or Mechanical Engineers.

Salary will be in accordance with Class M, Grade 8 (£1,440-£1,610 per annum) of the National Joint Board Agreement, plus 10 per cent allowance for shift duties.

Closing date for receipt of applications, 6th January, 1961.

These appointments will be pensionable within the terms and conditions of the Electricity Supply (Staff) Superannuation Scheme.

Applications should be submitted on the official form AE6/ACT which may be obtained from the Station Superintendent concerned and should be returned to him by the date stated.

O. S. WOODS,
Divisional Controller.

15th December, 1960. 7125

BRUSH ELECTRICAL ENGINEERING COMPANY LIMITED
Loughborough, Leicester

(A member of the Hawker Siddeley Group — Industrial Division)

INDUSTRIAL APPLICATIONS ENGINEER

Due to expansion in the industrial applications field this Company has a vacancy for a SENIOR ENGINEER in the Industrial Application Section of the Electrical Rotating Machines Engineering Department. A knowledge of drives in the rubber, plastics and associated industries and of related control systems is essential. Some practical experience of site testing and commissioning is also desirable.

Applications are invited from fully qualified men and preference will be given to Corporate Members of the Institution of Electrical Engineers.

Applications, WHICH WILL BE TREATED IN THE STRICTEST CONFIDENCE, should contain brief details of experience and qualifications and should be addressed to Mr. P. A. McCaig, quoting reference: PL.9904.

Brush Electrical Engineering Company Limited
Loughborough, Leicester.

7058

G.E.C.

has a vacancy for a

SENIOR TEST ENGINEER

in their Power Plant Division based at Erith, Kent.

This will involve efficiency testing and performance investigation of large turbo-alternator, blower and compressor plant in the U.K. and overseas, together with submission of test reports. Applicants should have had thorough experience in this field.

The post promises good prospects for a man with initiative and determination.

Apply in writing, giving full particulars of age, education and experience to :—

Personnel Manager (ECD)
THE GENERAL ELECTRIC COMPANY LIMITED
Erith, Kent

7097

SOUTH WALES ELECTRICITY BOARD

General Assistant Engineers

APPLICATIONS are invited for the following positions in the Cardiff and East Central Area :—

(a) Staff Vacancy Notice No. 184/60 (Re-advertised): GENERAL ASSISTANT ENGINEER, Rhondda District. Salary N.J.B. Class F, Grade 11, Scale 4 (£765/£870 per annum).

(b) Staff Vacancy Notice No. 219/60: GENERAL ASSISTANT ENGINEER, Cardiff District. Salary N.J.B. Class J, Grade 11, Scale 7 (£965/£1,090 per annum).

Preference will be given to engineers possessing a Higher National Certificate in Electrical Engineering.

Applications stating age, present position, present salary, qualifications and experience should be addressed to C. L. Townsend, Assoc.I.E.E., Manager, Cardiff and East Central Area, 445/447, Cowbridge Road East, Cardiff, to arrive not later than 11th January, 1961. Please quote reference (a) 184/60/ER or (b) 219/60/ER, endorsing envelope "General Assistant Engineer."

R. G. WILLIAMS,
Secretary. 7124

EASTERN ELECTRICITY BOARD

APPLICATIONS are invited for the following appointments. The successful candidates will be required to contribute to a superannuation scheme and may be required to undergo a medical examination.

TWO THIRD ASSISTANT ENGINEERS
(a) Luton District (330/60N).
(b) Hendon District (Ref. 1023) (331/60R).

Candidates should have had a sound technical training and suitable experience in the construction, operation and maintenance of H.V. and L.V. distribution systems, including substations.

Salary N.J.B. (a) Class J, Grade 9 (£1,115-£1,245); (b) Class G, Grade 9 (£965-£1,090) plus London allowance for (b).

Apply by letter, by 6th January, 1961, to :—
(a) W. G. Tree, Manager, Luton District, Eastern Electricity Board, 487, Dunstable Road, Luton.
(b) F. A. Moinet, Manager, Eastern Electricity Board, 137/139, Brent Street, Hendon.

7120

COUNTY BOROUGH OF BOOTLE

Senior Assistant Engineer (Electrical and Mechanical)

APPLICATIONS are invited from suitably experienced and qualified persons for the above position in the Borough Engineer and Surveyor's Department.

The appointment is subject to the National Scheme of Conditions of Service and the successful candidate, who should possess the Higher National Certificate in Electrical Engineering or other approved qualifications, will be required to take responsibility for all Electrical work, including Heating, Ventilation, Lighting and other work of similar character.

The salary will be in accordance with Grade APT.III £960-£1,140 per annum.

Applications, on forms obtainable from the Borough Engineer and Surveyor at the address below, with the names of two referees, should be delivered to him not later than noon on Friday, the 6th January, 1961.

HAROLD PARTINGTON,
Town Clerk.

Town Hall,
Bootle, 20,
Lancs. 7126

HAPPY IN YOUR RUT?

YES? Well, this advertisement will not interest you, but for those seeking fresh fields for expression of talent and individuality as

PRODUCT DEVELOPMENT & RESEARCH ENGINEERS

we can offer permanent pensionable positions with four-figure commencing salaries and excellent advancement potential. The successful applicants, age 30 plus, will be required to develop an interesting range of electric motor control gear widely used in a variety of applications from guided missiles to paper manufacturing machinery.

Vacancies also exist for engineers below this grade.

West London company.

Please write in confidence giving details of age, experience, qualifications, etc., to—Box 7048.

TRANSFORMERS & RECTIFIERS LTD.

MILLMEAD, GUILDFORD, SURREY

require

DESIGN ENGINEERS
TEST ENGINEERS
DRAUGHTSMEN

The company is expanding and shortly moving to new and larger premises.

Good salary and excellent prospects.

Housing assistance possible for the right men.

7010

CHARTERED ELECTRICAL ENGINEER

A VACANCY exists for a Chartered Electrical Engineer, age 30 to 35, with a Hydro-Electric Power Undertaking in Northern Nigeria. Pleasant climate 4,000 feet above sea level.

Salary grade £1,335/£1,565 according to age, qualification and experience. Pension and life assurance scheme. Eighteen months' tours with three months' leave on full salary. Free furnished quarters. Free passages self, wife and two children, or equivalent benefits if children remain at home.

Write Box E.996, c/o Streets, 110, Old Broad Street, London, E.C.2. 7054

BEDFORDSHIRE COUNTY COUNCIL EDUCATION COMMITTEE

APPLICATIONS are invited for the following appointment at MANDER COLLEGE, BEDFORD, as from 1st January, 1961 :—

ASSISTANT LECTURER Grade B, mainly for ELECTRICAL INSTALLATIONS courses.

Salary in accordance with Burnham Technical Report.

Forms of application and further particulars available from the College Principal. (Stamped addressed envelope, please.)

T. S. LUCKING,
Clerk to the College Council.
7123

ELECTRICAL ENGINEER

ASSISTANT ENGINEER required for the London office of a West African opencast mining company. Applicants, who must be Associate or Graduate Members of the Institution of Electrical Engineers, should have had general experience of switchgear and electrical distribution on systems up to 3,300 volts, and preferably some knowledge of electronics.

The work is interesting and varied and will cover both mechanical and electrical matters.

Bonus and pension schemes.

Applications, giving full particulars and salary required, to—Box ER.966, c/o Hanway House, Clark's Place, London, E.C.2. 7103

AN experienced outside sales representative of good education and with a sound electrical background, is required by Crompton Parkinson Limited, to sell their Induction Motors on his own initiative in the Hull area. This is a staff appointment, carrying a good salary and pension benefits. Please apply for application form to MA/P2, Crompton House, Aldwych, London, W.C.2. 7127

CABLE engineer, experienced in the manufacture and design of impregnated, paper-insulated, solid-type power cables of all voltages, required as liaison engineer. Duties will involve the technical aspects of standardisation, rationalisation procedures and quality control. Please write with full details of experience, qualifications, etc., to the Staff Officer, ref. 736/55/ER., Associated Electrical Industries Ltd., London, S.E.18. 7098

DRAUGHTSMAN, electrical, with experience in switchboard and fusegear design. A.E.S.D. rate and superannuation. Write stating full particulars to—Artic Fuse & Elec. Mfg. Co. Ltd., Birtley, Co. Durham. 7122

ELECTRIC lamp manufacturers require production men with experience on high-speed lampmaking machinery. Apply in writing stating experience and salary required. Skilled fitters and millers also required in our lamp machinery division. Top rates to the right men.—Box 7055

ELECTRICAL breakdown man required in January. Minimum rate 6s. 6½d. per hour plus 4-room flat accommodation in North London.—Box 188.

ELECTRICAL wholesalers have vacancy for assistant manager of their sales order office, also sales order clerk. Only applicants with previous experience in similar business will be considered. Salary £750/£1,000 according to ability. Full details to—Box 7099.

ESTABLISHED electrical contractor in Kuwait wishes to form a register of qualified men in the following trades willing to engage on short term contracts, approx. one year, starting in the new year. Foreman armature winder, foreman installation electricians, foreman jointers, foreman linesmen. These men to be preferably in the age group 30-35, and capable of controlling and training local staff, previous Middle East experience an advantage. Salaries in the range £130-£160 per month, air fare from and to London, plus reasonable expenses, furnished accommodation in Kuwait, and accumulated holiday pay at the rate of 2½ days per month of service. Applications to be appended to this register, with full details of previous experience, should be addressed to—R. L. Brown, General Manager, K.F.C.E., P.O. Box 7056, Fahaheel, Kuwait. Interviews will be conducted in the U.K. for selected personnel; chance of permanency. 7694

ESTIMATING, site supervising and design engineer required for high-class installation work of all descriptions. Permanency and good immediate prospects for keen and able engineer. Write stating age, experience and salary required to—Mr. C. King, Alliance Electrical, 2, Henrietta Street, London, W.C.2. 137

OVERHEAD line surveyor required with experience of obtaining wayleaves. Good salary and prospects.—Box 7036.

OVERHEAD linesmen required with experience. Good prospects and wages.—Box 7037

POWER cable sales engineer required by well-known manufacturer. Area of operation South-East England. Experience in paper-insulated and thermoplastic cables necessary, together with selling experience to electricity boards, contractors and industrial users. Age 25-35. Apply giving full details of experience and qualifications to—Box 7114.

RADIO and television engineer wanted for old-established radio shop with all leading agencies. Write stating age, experience and salary required.—The Music Box, 89, London Road, London, S.E.1. 7090

REPRESENTATIVE required by leading electrical wholesaler for Essex. Also London vacancies. Must be experienced and well connected in industry.—Halsey's, Brandon House, Wyfold Road, London, S.W.6 (FULham 3355). 7115

SENIOR assistant electrical engineer required by consulting engineers in London W.1 area; capable of complete design and control of large and small electrical installation contracts. Commencing salary in the scale £1,250-£1,500 per annum, plus luncheon vouchers. Successful applicant would be expected to join the superannuation scheme.—Box 7104.

SIMPSON BROS. (of Hapton) Ltd. have a vacancy for an assistant manager for electrical contracting department. Must be experienced in large industrial and commercial contracts. Excellent opportunity for the right man. Apply—Simpson Bros. (of Hapton) Ltd., Hapton, Burnley, Lancs. 7116

Situations Vacant (continued)

SITE measuring surveyor required for the measurement and evaluation of electrical installations. Applications in writing in the first instance stating age, experience and salary, etc., to—Frank N. Falkner & Partners, Chartered Quantity Surveyors, Windscale Works, Seascale, Cumberland. 7025

APPOINTMENTS FILLED

Dissatisfaction having so often been expressed that unsuccessful applicants are left in ignorance of the fact that the position applied for has been filled, may we suggest that Advertisers notify us to that effect when they have arrived at a decision? We will then insert a notice free of charge under this heading.

SITUATIONS WANTED

BUYER (43), 14 years' experience purchasing, electrical and mechanical accessories, appliances, plant and packing materials. Qualified engineer, staff control, stock records, etc. —Box 7685.

PAPER mill chief electrical engineer seeks change. Experienced in design, planning, installation and maintenance. Ex-Harland sectional drive specialist.—Box 7690.

SALES representative, aged 38, redundant due to merger, experienced cable industry and electrical/engineering products. Good administrator and correspondent. Resident Leeds but would move.—Box 7691.

TECHNICAL representation in S.E. offered by qualified electrical engineer on freelance or part-time basis; own office, transport, etc.—Box 7688.

TECHNICAL sales development engineer (49), resident East Anglia, desires change to progressive company. Experienced liaison work and negotiation at director/chief engineer level. Good standing with board, industry and municipalities.—Box 7684.

ARTICLES FOR SALE

MOTORS

NEW CROMPTON PARKINSON, from ¼ h.p. to 80 h.p.; also 6,000 A.C. and D.C. reconditioned Motors and Starters.

IN STOCK HERE

B. E. WHITE
Brantwood Rd., Tottenham, London, N.17
Tel. EDMonton 4621-2 215

HOUSE SERVICE METERS

200-240-v. A.C. or D.C., 10 amps. capacity, quarterly type, from 25s. each, plus 2s. 6d. carr.

UNIVERSAL ELECTRICAL CO.
221, City Road, London, E.C.1 37

A.A. ELECTRICAL Co. for A.C.-D.C. motors, switchgear, exhaust fans, hoists, reduction gears, new or reconditioned units.—CHI. 5105. 67, Rothschild Rd. London W4. 57

ABABCOCK & Wilcox water tube boiler will cut down your fuel costs; we can supply from stock. Two 40,000 lb. evap., 220 lb. w.p.; one 25,000 lb. evap., 200 lb. w.p.; 3,000 lb. evap., 400 lb. w.p.; Spencer Bonecourt boiler; also Marine, Cornish, vertical, etc.—Burford, Taylor & Co. Ltd., Boiler Specialists, Burtayco House, Church Street, Middlesbrough (Tel. Middlesbrough 2622). 122

A.C. and D.C. motors, generators, from stock.—Service Electric Co. Ltd., Honeypot Lane, Stanmore, Middx. (Edgware 5566/9). 91

A.C. and D.C. 1/- slotmeters. Guaranteed 2 years, 2½-50 amps. From 55/-. Repairs and recalibrations. See Billiard: Tradex Meter Co., Surbiton (Tel. Elmbridge 2234/5/6). 169

ALTERNATORS and generators, all types up to 150 kW.—Powerco Ltd., 312, York Road, London, S.W.18 (VAN. 5234). 151

ALTERNATORS for sale from 1,100 kVA at 750 r.p.m. down to ½ kVA. Single and three-phase. All voltages. More than 150 machines in stock. Automatic regulators and switchboards available.—Fyfe, Wilson & Co. Ltd., Station Works, Bishop's Stortford. 162

ALTERNATORS, 3-phase, all sizes in stock from 7 kVA up to 330 kVA.—Britannia Manufacturing Co. Ltd., 22/26, Britannia Walk, London, N.1 (CLErkenwell 5512). 24

BARGAINS in electric motors from A. Cooksley & Co. Ltd., 21/25, Tabernacle Street, London, E.C.2. Ring Monarch 3355. 50

BILLIARD Meters. 1/-, 6d. or 1d. slot. All time settings. From 170/-. See Quarterly.—Tradex, Surbiton. 170

CABLE, underground, all types ex stock.—E. M. Tatton Co. Ltd., Kew Bridge, Brentford (ISLeworth 4534/5). 117

CABLE, underground, PILC/VIR/LC, ex London stock. Cutting orders same day delivery London area. Send for priced stock lists. — Batt Electrical Co., 6, Dock Street, London, E.1 (Tel. ROYal 5905). 316

CIRCUIT-breakers, various sizes in stock, A.C. and D.C., 200 amperes up to 2,000 amperes. Also dynamo and alternator switchboards. — Britannia Manufacturing Co. Ltd., 22/26, Britannia Walk, London, N.1. 26

CONVERTERS, motor-alternators, motor-generators, frequency changers, etc. All types up to 100 kW.—Powerco Ltd., 312, York Rd., London, S.W.18 (VAN. 5234). 150

CRANE motors. Direct current, series wound or compound wound, all voltages. We have large stocks.—Britannia Manufacturing Co. Ltd., 22/26, Britannia Walk, London, N.1. 22

DIESEL generating sets, all sizes to 500 kW. Britannia Mfg. Co. Ltd., Britannia Walk, London, N.1. 16

ELECTRIC motors and generating equipment.—E. M. Tatton & Co. Ltd., Kew Bridge, Brentford (ISLeworth 4534/5). 116

ELECTRIC motors, dynamos, alternators and motor generator sets of all sizes. We hold one of the largest stocks in England. New and reconditioned, with 12 months' guarantee.—Britannia Manufacturing Co. Ltd., Britannia Walk, London, N.1 (Clerkenwell 5512, 3 lines); also Works and Stores, Chobham, Surrey. 20

ELECTRIC motors, generators, motor generator sets, transformers, switchgear, etc., large comprehensive stock, overhauled and guaranteed. Copy of our Register, "Electrical Surplus," containing thousands of items of electrical plant, sent on request.—R. F. Winder Ltd., Belgrave Electrical Works, Leeds, 2. 54

FLUORESCENT tubes reconditioned and guaranteed with a life as new for 7s. 6d. each. Free collection and delivery in Lancs. and Yorks. Save 40% on your tube replacement costs by using this service. We are also manufacturers of top quality fluorescent fittings, trunking systems, control gear and new fluorescent tubes. Generous discounts available.—Anglo-American Electrical Company, Clive Street, Bury (Telephone, Bolton 7251). 212

FOR sale, good, unused and used machinery, including electric motors, A.C. and D.C. dynamos, alternators, transformers, diesel and steam electric generating sets, mains failure sets, motor generator and Ward Leonard sets, switchgear, compressors, fans, capacitors, etc.—Fyfe, Wilson & Co. Ltd., Station Works, Bishop's Stortford, Herts (Tel. B.S. 1000/1). 161

GENERATING sets, portable or stationary, new and reconditioned, 1 to 100 kW, A.C. and D.C. — Powerco Ltd., 312, York Road, London, S.W.18 (VAN. 5234). 148

KARDEX, Roneodex and Shannovue cabinets, as new.—F. H. Jolly & Co. Ltd., 289, King St., London, W.6 (RIV. 5381). 202

LARGE stock of various surplus, electrical insulating materials in sheet, strip, tube, bar and rod form, plus a big quantity of 12" × 8" pieces of Paxolin sheet from 1/16" up to ¼" thick; also large quantity of light screened cable in various sizes.—Woodfield & Turner Ltd., Burnley (Tel. 78134). 7072

MOTOR generator sets and converters, all sizes and voltages from ½ kW up to 500 kW in stock. — Britannia Manufacturing Co. Ltd., 22-26, Britannia Walk, City Road, London, N.1 (Tel. Clerkenwell 5512, 5513 & 5514). 12

MOTORS and control gear, huge stocks all types, ¼ to 200 h.p.—Ramsbottom & Co. Ltd., Elec. Engineers, Keighley (5444/7). 70

NAMEPLATES, engraving, diesinking, stencils. — Stilwell & Sons Ltd., 153, Far Gosford Street, Coventry. 108

NEW Brook 2-h.p., 240-volt, 1,000-r.p.m. drip-proof foot-mounted motor with slide rails and starter. New price £49 5s. Will accept £35 or near offer.—T. M. Kingdon & Co. Ltd., Market Place, Basingstoke, Hants. 7105

PHASE converters, single to three-phase, several sizes in stock up to 90 h.p., 3-phase loading.—Britannia Mfg. Co. Ltd., Britannia Walk, London, N.1. 29

PLATING dynamos and motor generator sets, various sizes from 500 amps. up to 2,000 amps., with A.C. and D.C. motors.—Britannia Manufacturing Co. Ltd., 22/26, Britannia Walk, London, N.1. 15

POLYPHASE kilowatt hour meters. Available from stock.—Universal Electrical, 221, City Road, London, E.C.1. 40

PREPAYMENT 1s. slot house service meters. —Universal Electrical, 217-221, City Road, London, E.C.1. 36

PURLEY chokes and ballasts. Our 80-w. tapped h.p.f. ballast with starter switch-holder incorporated is proving itself the most popular unit. Suitable for most fittings, 57s. 6d. each subject.—F. W. Blanshard Ltd. (Dept. ER), Purley, Surrey (Uplands 4818/9). 52

QUARTERLY credit meters, single and poly-phase, 2½-100 amps. From 20/-. Also D.C. See Television.—Tradex, Surbiton. 171

ROTARY converters in stock, all sizes; enquiries invited. — Universal Electrical, 221, City Road, London, E.C.1. 34

SMALL BR screws and nuts in steel, brass and stainless steel, from stock. — Premier Screw & Repetition Co. Ltd., Woodgate, Leicester. 180

TELEVISION slotmeters and time switches. Details from: Tradex Meter Co., Surbiton (Elmbridge 2234/5/6). 172

VENNER time switches, 200-240 v. A.C./D.C., 10-50 amps., from stock.—Universal Electrical Co., 221, City Rd., London, E.C.1. 38

WARD Leonard motor generating sets, all sizes.—Britannia Manufacturing Co. Ltd., 22-26, Britannia Walk, London, N.1 (Tel. Clerkenwell 5512). 10

WESTALITE rectifier, A.C. input 340/440 volts, 3-phase, 50 cycles; D.C. output 40 amps., continuous rating.—Mitchell & Co. (Printers) Ltd., 53, High Street, Arundel, Sussex. 7693

40-h.p. Veritys Aston motor, ball-bearing type, 720 r.p.m., 3-phase, 50 cycles, 380 volts. Slipring type. Recently overhauled, in good condition. Also Veritys Aston starter, 40 h.p., 50 cycles, suitable for above motor. Apply—Connollys (Blackley) Limited, Blackley, Manchester, 9. 7119

40/20-h.p., 950/480-r.p.m. Lancashire T.E.F.C. slipring motor with Igranic automatic control panel giving 2-speed control forward and reverse, 415 volts, 3-phase, 50 cycles. Details from—Dynamo & Motor Repairs, North End Road, Wembley Park, Middx. 90

180-h.p., 970-r.p.m. T.E.F.C. slipring motor by Lancashire, 400 v., 3-phase, 50 cycles, complete with fully automatic starting panel. Further details from—Dynamo & Motor Repairs Ltd., North End Road, Wembley Park. 77

188-kW motor generator by Crompton Parkinson, output 67/90 volts, 2,440 amps. D.C., with 280-h.p., 580-r.p.m. slipring motor, with starter for 400/440 volts, 3-phase, 50-cycles. Two similar sets available for single or parallel operation with switchgear and meters. Details from—Dynamo & Motor Repairs Ltd., North End Road, Wembley Park, Middx. 89

400-cycle to 1,500-cycle motor alternators and alternators.—Britannia Mfg. Co. Ltd., Britannia Walk, London, N.1. 27

500-kW, 220-volt Met.-Vick. rotary converter, with transformer, 11,000 volts, 3-phase, 50 cycles, and accessories.—Britannia Mfg. Co. Ltd., Britannia Walk, London, N.1. 17

500/625-kW L.D.C. generator, 240 volts, 2,080/2,600 amps., D.C., compound interpole with single bearing for direct coupling at 1,000 r.p.m., or on combination bed with new L.D.C. slipring motors, 900 h.p., 990 r.p.m., 3.3 kV or 6.6 kV, complete with switchgear, in approximately six months. Also duplicate generator and spare armature. Further details from Dynamo & Motor Repairs Ltd., North End Road, Wembley. 84

EQUIPMENT FOR HIRE

GENERATING set hire service. Consult the most experienced firm for A.C. and D.C. units from 2 kW to 240 kW, diesel or petrol, stationary or mobile, sale or hire, 24-hr. breakdown service. — Dawson-Keith Ltd., Hillview Rd., Sutton, Surrey (Fairlands 4401). 46

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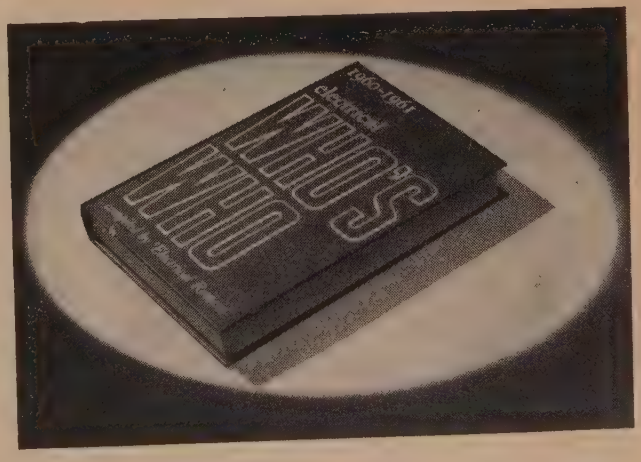

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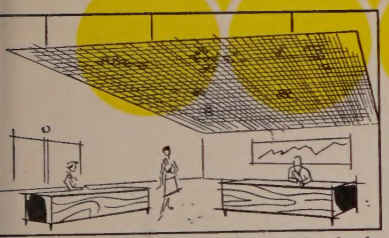

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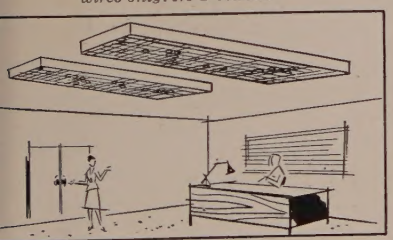

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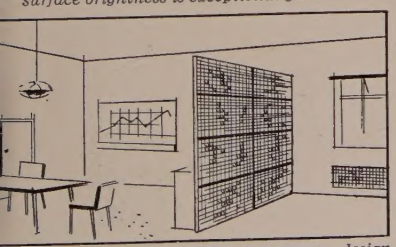

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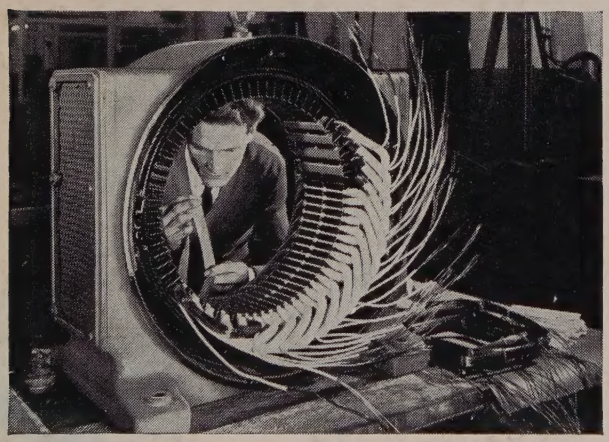

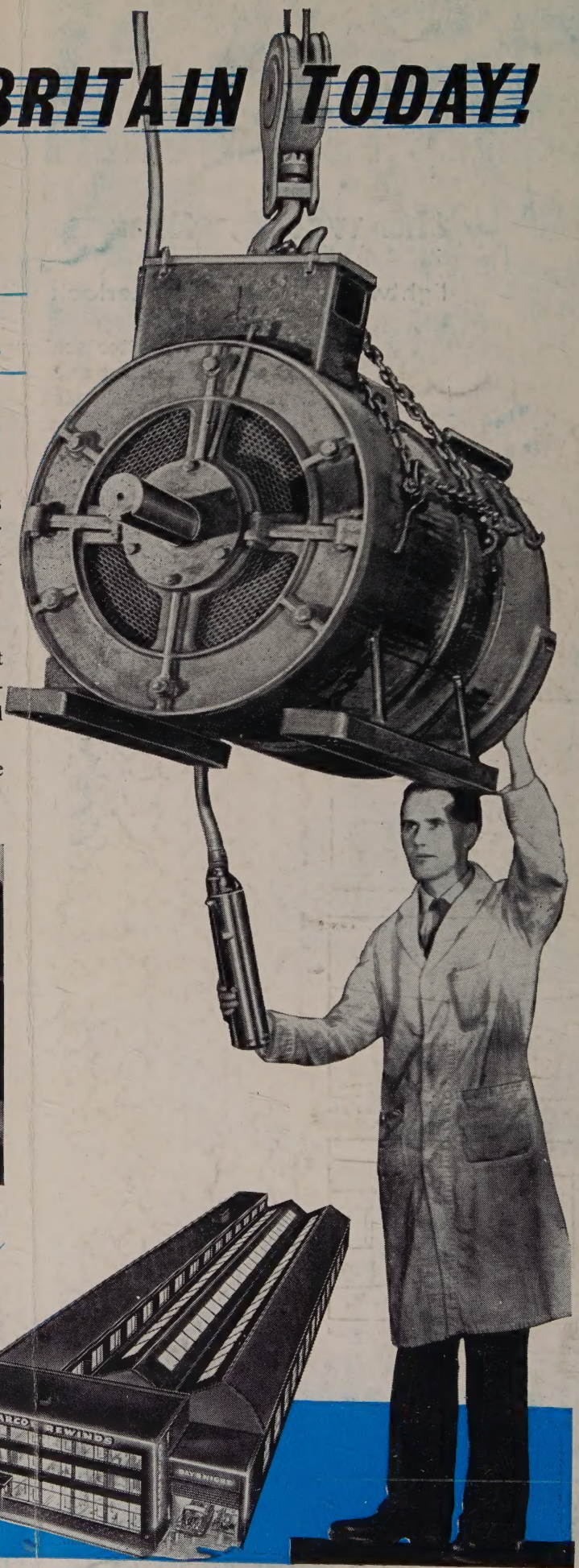

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